SPECTRAL MUSIC
AND HIGH SCHOOL STUDENTS

David Gerard Matthews

One of the most intriguing aspects of the scores of the spectral school has been the convincing use of new sounds and instrumental techniques within the framework of instrumental composition. Spectral composers have successfully assimilated many of the disparate techniques of late high modernism, including the use of microtones, noise, and electronic synthesis and processing, while maintaining their own distinctive musical language. Indeed, spectralism might be seen as one possible solution to the problem of finding an internally consistent musical grammar rich enough to match the enormous sonic vocabulary that composers had at their disposal by the 1960s and 1970s. While one could never accuse the French spectral composers of the sort of free-wheeling eclecticism popular in some circles, spectralism draws upon a broad range of influences, including the French modernist tradition of Debussy, Messiaen, and Boulez, Ligeti's explorations of texture and micropolyphony, Xenakis's stochastic compositions, and Stockhausen's sonic explorations. To these must be added, of course, the deep and lasting influence of electronic music and acoustics. Yet, for all its concern with the science of sound and the creation of musical systems, spectral music is above all an aural music. Spectral composers tend to be seriously interested in, and aware of, the practical techniques, problems, and possibilities of instrumental performance. Compared to serial works, spectral compositions (especially those of the 1970s and early 1980s) tend to unfold along a linear path, following clearly audible processes. A spectral work might contain the full range of sonorities, from justly tuned triads to microtonal clusters, from completely unpredictable, aperiodic rhythms to steady metrical pulses, and from conventional playing techniques to noise (or even silence.) Yet these disparate elements are deployed along a continuum, and obey a rigorous, though never arbitrary logic. The spectral path could be seen as one possible solution to the problem of creating a cohesive musical language from the disparate elements of mid-century modernism.

Not surprisingly, spectral scores can constitute a rich resource for the study of contemporary performance practice. A perusal of canonical spectral scores, from the 1970s to the present, will reveal many techniques of notation and performance with which new music specialists are expected to be familiar. Spectral composers have been particularly adventurous in the use of so-called extended techniques, requiring string players to perfect a variety of bowing techniques, and utilizing multiphonics and breath noises from wind players.[41] Spectral harmonies range from simple consonances to dense microtonal chords. The field of rhythm has also not gone unexplored, with spectral composers exploring the full gamut from relatively regular and periodic rhythms through to completely aperiodic. Spectral composers have utilized semi-proportional notation (especially in Grisey's earlier works) as well as fully symbolic, often highly complex irrational divisions of the tactus.

While spectral composers have never courted difficulty of execution purely for its own sake, it remains obvious that most spectral works make considerable demands on the performers. Spectral composers have generally been written by specialists in the field of new music performance, who often have considerable exposure to the wider body of music since 1950[42] and who tend not to be intimidated by the use of extended techniques or non-periodic rhythm. Spectral music has therefore unsurprisingly not found a broad acceptance among non-specialist musicians and ensembles comparable to that of the music of certain minimalist or neo-romantic composers.

Despite these obstacles, music in the spectral vein could constitute an excellent introduction to the world of new music for student musicians. Currently in the USA (and, one would suspect, in other countries as well), many high school ensembles are actually quite proficient, but their repertoire consists largely of pieces in an extremely conservative neo-tonal language written by composers who specialize in music for educational use. Unfortunately, these students are generally quite ignorant of the mainstream of modernism and post-modernism in so-called art music. They are, however, often familiar with popular electronic-based genres, such as ambient and techno-rock, and may be quite receptive to the timbrally rich soundscapes of much spectral music. Spectral music, then, can serve as a highly appropriate introduction to the wider world of new music outside the

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[41] Of course few, if any, of these techniques originated with the spectral composers.

[42] In fact, it is worth noting that the earliest spectral works originated in the context of the l'Itinéraire group, a kind of network of composers (including Murail, Grisey, and Levinas, amongst others) and performers working in close collaboration.

popular realm. Unfortunately, prior to my own work, the only spectral work specifically for student musicians known to me is Grisey's *Pour obtenir un air de jeu*. The unusual instrumentation of this piece, however, makes it inappropriate for most school ensembles, at least of the kind typically found in the USA.

My composition, *Adagio*, was the result of a commission by the North Hills High School Symphony Band in Pittsburgh, Pennsylvania. Uniquely among high school wind bands, this organization has commissioned a new work every year for over 30 years. Most of the composers commissioned by the band specialize in music for such ensembles, but a few have been relatively well-known American academic composers, such as Donald Freund and David Liptak. The band has had a strong regional and national reputation for excellence, and a large number of its graduates have gone on to pursue further studies in music.

In writing for this ensemble, I had at my disposal an extremely sympathetic conductor who was nonetheless relatively unfamiliar with the musical language I had chosen. I also was confronted with a group of sixty-something enthusiastic but somewhat inexperienced young musicians. In composing the work, I deliberately tried to adhere closely to the strengths and weaknesses of the band, and to create a piece that remained true to my aesthetic goals while still being accessible to the student musicians. To this end, I consulted closely with the group's conductor, and examined other scores that they had played. I attended rehearsals and performances of the group while working on the piece, and gained something of an idea of the possibilities of the ensemble.

To those unfamiliar with its sound, the large wind ensemble[43] offers an enormous variety of timbral possibilities. It is true that the overwhelming majority of the wind ensemble repertoire is mediocre at best, but that is

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[43] Properly speaking, the term "symphonic band" refers to a larger group, with multiple players reading from the same part. At a minimum, there will typically be three or four players for each clarinet part, and often most or all of the other parts will be doubled as well. The term "wind ensemble" or "wind orchestra" typically refers to a somewhat smaller group, generally with single players on each part. Many American music schools have both a "symphonic band" and a "wind ensemble," the latter being an elite group which focuses on more serious repertoire, often including the wind music of Mozart, Stravinsky, Schoenberg, and Messiaen. Because of the associations with this repertoire (as opposed to the more typical "band" repertoire of marches and transcriptions), the term "wind ensemble," has sometimes been adopted even by larger groups, especially since the term "band" currently has strong associations with jazz and rock music.

timbral possibilities one can obtain through the combination of winds and percussion makes the combination particularly attractive in a spectral context. Many wind ensembles include such "coloristic" instruments as the English horn, contrabass clarinet, soprano saxophone, flugelhorn, vibraphone, and keyboard (piano or synthesizer). Piccolo, bass clarinet, the full saxophone family, and euphonium (baritone horn) are standard. In the case of my work, I used a slightly expanded ensemble, with a large percussion section hardly the fault of the particular instrumental combination. The wealth of, two synthesizers, and a double bass. Like most high school wind bands, the North Hills ensemble had a large number of flute, clarinet, and trumpet players. Just as many contemporary orchestral composers have eschewed the string choir preferring to score for solo string parts, I wanted to avoid the thick sound of doubled winds. Therefore, I scored five separate flute and piccolo parts, eight clarinet parts (from E♭ soprano to E contrabass), and five trumpet parts.

Once the limits and possibilities of the particular ensemble were known, I began the actual compositional process. This particular piece is in fact a recomposition of an earlier work, for orchestra, which had not been performed in its original form. I had determined that the piece could be successfully re-orchestrated to fulfill the demands of the commission. Over the course of the recomposing process, the surface of the piece changed dramatically, although it is essentially similar in form.

The piece uses the spectra of various sorts of bells as beginning and ending points. Intermediate harmonies were produced through the technique of frequency interpolation. Although there is no reference to serial procedures in the pitch structure of the piece, there is a duration series that is used, rather freely and inconsistently, throughout the piece. One of the most notable aspects of the composition is the low A heard throughout as a drone; this pitch is the apparent fundamental of all the harmonic and inharmonic spectra heard.

The great problem remained, then, to present this work in a more or less spectral idiom to student musicians. Prior to the first rehearsal, I played for the conductor selections from recordings of various pieces that had inspired me. These included works such as Grisey's *Les Espaces acoustiques* and *Quatre Chants pour franchir la seuil* and Murail's *Allegories* and *L'Ésprit des dunes* as well as non-spectral works by Ligeti and Mahler and Thomas Tallis's *Spem in Alium*. We discussed many of the technical problems, many of them related to rhythm. While much of the wind band literature makes use of mixed or asymmetrical meters, and syncopation is frequent, the students were quite unused to music in which there is little or no perceptible

pulse. Furthermore, the concept of texture, or timbral complex, arising from dense polyphony, was a new one for both the conductor and the ensemble. I compared the intended effect with Tallis forty-voice motet, in which the movement of individual lines is often blurred, resulting in a dense mass of sound through most of the piece.[44] (There are of course, moments of homophony or polyphony of a more intelligible sort.)

It was here that the inevitable problem of notation emerged. In an earlier piece,[45] I had used proportional notation for the representation of non-periodic rhythms, with the assumption that this would be easier for the performers to understand than the sort of complex rhythms that, had I used traditional notation, would inevitably be a feature of the music. In the course of rehearsing this piece, however, I found that proportional notation is often confusing to the performers, who, if anything, were more likely to try to impose a metrical grid where none existed. This experience convinced me of the need to use some form of traditional notation. Although the actual unit of duration in compositional terms was the second, I needed to translate this into traditional symbolic rhythmic terms that could fit into a clear meter, at least on paper.

As was previously mentioned, the students were quite familiar with mixed meters, syncopations, and polyrhythms in the context of a perceptible rhythmic tactus. They had never before experienced a sort of music where the deliberate blurring of the pulse is a salient feature of the musical language. For practical purposes, a tempo of quarter note = 60 in 4/4 meter was used throughout, but with many subdivisions of triplets, quintuplets, and sixteenth notes. Although the particular rhythmic demands are relatively modest compared to works for specialist musicians, subdivision without a clearly articulated tactus proved to be one of the major challenges of rehearsals.

The conductor carefully marked all of the rhythmic subdivisions, and spent much rehearsal time training the ensemble to execute them accurately. As a rehearsal technique, he would frequently use a snare drum or amplified metronome, beating out the quintuplets or triplets against the quarter-note pulse so that the students could hear how their individual parts related to

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[44] I do not claim that it was Tallis's intention to produce an effect of massed sonority, akin to the effect of Ligeti's works of the 1960s. This is certainly the effect, however, that the piece has on most modern listeners, myself included.

[45] *A Thousand Regrets*, for sixteen musicians, commissioned and premiered by the Duquesne University New Music Ensemble, Pittsburgh, Pennsylvania, conducted by David Stock.

subdivisions. The frequent use of asymmetrical divisions of the triplet or quintuplet posed particular problems. Here the conductor adopted the strategy of teaching the rhythms to the students by having them play scales on the asymmetrical rhythm, for example using the eighth-note/dotted-eighth-note quintuplet, while the snare drum beat the quintuplet subdivisions. In this way, the students eventually became more accustomed to the rhythms.

If the rhythmic language was unfamiliar to the members of the band, then the harmonic language was even more so. While they had played some pieces that worked outside the framework of functional harmony, the students had certainly had no prior exposure to microtones. By relating harmony to timbre, however, and explaining how each sonority in the piece relates to the drone-fundamental, the students were able to understand the harmonic idiom. Before the first rehearsal, I struck a tubular chime and let it ring until the sound died away naturally, asking the students to listen closely to the sound. I asked them to try to hear individual sounds within the chime sound, and to try to hear the chime sound as a chord rather than as a single pitch. I then asked them to try to go from hearing the sonority as a single sound to a hearing it as a chord and back again. I explained that this piece was based on these sorts of ideas, and that the last chord of the piece came from the spectrum of a tubular chime.

Rather than ask the wind players to learn special fingerings or lip positions for the non-tempered pitches, I asked ten musicians (one flute, one oboe, two clarinets, one tenor saxophone, two horns, two trumpets, and a synthesizer) to tune a quarter-tone flat in order to facilitate the production of microtonal harmonies. The detuned synthesizer provided a stable pitch reference for the detuned instruments, with the non-detuned synthesizer providing a pitch reference for the rest of the ensemble.

Naturally, detuning presented difficulties in and of itself. Unsurprisingly, the instruments were also much less responsive when working at a pitch level below A=440, something I kept in mind when scoring the work. For this reason, the detuned instruments have relatively simple parts. Nevertheless, the players could never quite overcome the natural tendency to correct what they (subconsciously) perceived as faulty intonation. (This was especially true of the brass players.) In the case of the woodwinds, it was difficult even physically to tune the instruments to this low pitch. For example, the tenor saxophonist was in constant danger of losing his mouthpiece, because it was so far extended from the neck of the instrument. The players of the detuned instruments tuned to the synthesizer and used an electronic tuning meter as a reference, but getting them to agree with one

another in intonation after the initial tuning was very difficult, and their pitch relative to each other was often unstable. Therefore, the decision was made to seat them together, apart from the players of the non-detuned instruments. At first, they frequently rehearsed separately from the rest of the ensemble. Each rehearsal of the detuned group would begin by having them play a major scale at detuned pitch to give them a chance to get accustomed to the flat pitch level. We also would rehearse with the detuned players playing their part over the (non-detuned) fundamental A, so that they could hear how the non-tempered partials fit into the spectral harmony of the piece. Although they eventually did become more comfortable with the microtonal harmony, the students never did quite overcome the tendency to raise the pitch of the detuned instruments.

Example 1. *Adagio,* Measures 100-101, Showing Irregular Triplet and Quintuplet Divisions. All musical examples are in concert pitch.
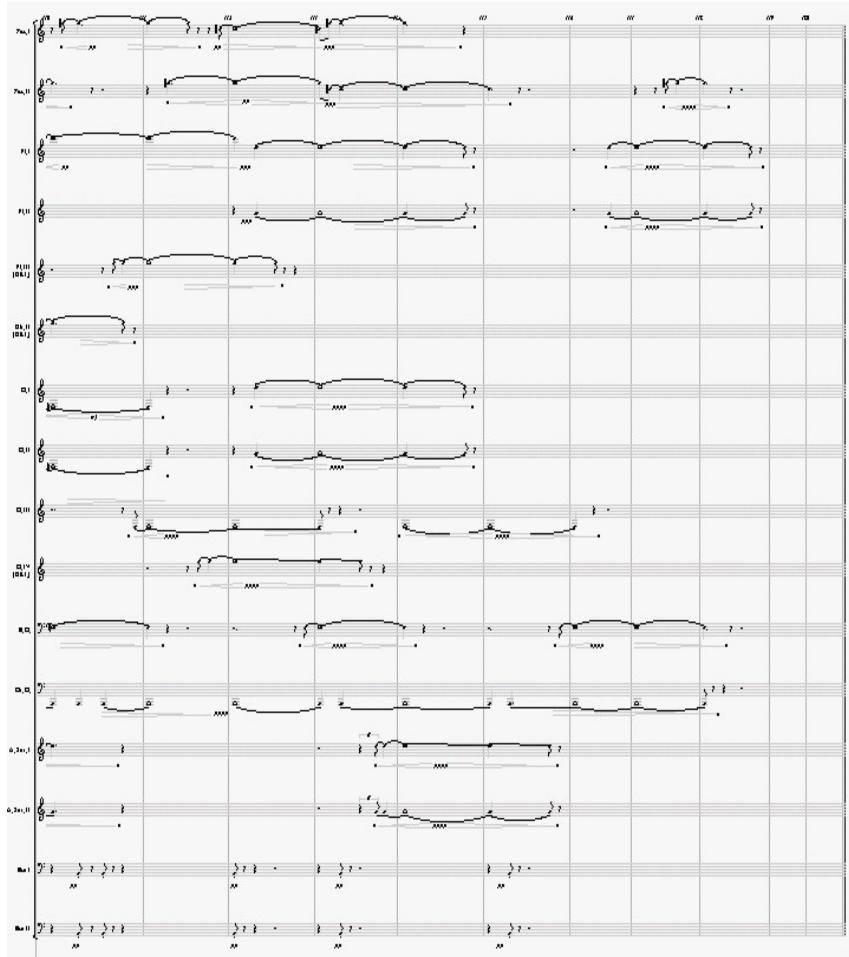
Example 2. The Final Sonority of *Adagio*, Woodwinds Only. The pitches are derived from the spectrum of a tubular chime.

If aperiodic rhythms and non-tonal harmonies presented great difficulties to the students, then the problems of ensemble playing were even greater. The students were not really familiar with music without a clear division of melody and accompaniment. Although I had wanted to play musical examples for the students similar to those I played for the conductor, a lack

of precious rehearsal time prevented it. I did, however, explain that they are all equally important in creating a musical texture, the whole of which is at least different from, if not greater than, the sum of its parts. I explained that they must be extremely sensitive to dynamics, which ranged from *niente* to sextuple *forte*. The fade-in/fade-out gesture (from *niente* to a stable dynamic level and back to *niente*), typical of this work, was very difficult for them at first, but became more comfortable for them with time. I also explained that the use of microtones did not give them license to play out-of-tune; in fact, it demanded that they be more sensitive to problems of intonation. The conductor had pointed out to the students that the full effect of the aggregate of sounds would probably be apparent to the audience, but not necessarily to the individual players. This accurate observation reflects the difficulty of performing music based on principles of timbral and harmonic fusion with large ensembles in general.

Spectral music is, of course, the music of timbre and of transition, and one of the most characteristic gestures of this piece is the gradual transition of a sustained tone from one timbre to another as one instrument fades out and another fades in. Here, all of the challenges discussed came to the fore: the players must have extremely accurate timing, they must have perfect dynamic control, and the intonation must be flawless. I made an analogy to the filter sweeps characteristic of techno music, a pop music genre with which most of them were familiar. Once the students had a frame of reference, it became quite natural for them, although naturally the execution was not always perfect.

Other aspects of the piece also proved to be amenable to analogies with more familiar musical idioms. For example, at one point in the piece, the brass have short, crisply articulated notes that occur at irregular temporal intervals, representing the transients of a bell tone. The trumpet players referred to these short attacks as "jazz band hits," making an analogy with the sharp attack of big-band brass playing. The conductor and students were also able to relate the slow harmonic rhythm to various pieces in a more minimalist idiom, which they had played.

After several weeks of rehearsal, the work was premiered. Of course, more rehearsal time would have been valuable, but it did seem that the students were making progress in their understanding of it. The first performance, though admittedly not perfect, was certainly satisfactory, especially for a student ensemble, and the piece was very well received. It was especially interesting to note the remarks about the piece made by the friends and family members of the performers, none of whom had significant exposure to new music. Following the performance, the recording of the

concert was played for the members of the band, who were, as predicted, surprised by the actual sound of the music from the audience. (Microphones were placed in the hall to capture maximum room resonance.) Students remarked that they were able to hear the shifting timbres, and the sonic fusions that I had intended. I was gratified to know that most of them seemed genuinely to like the piece.

Example 3. *Adagio***, Measures 54-62, Woodwinds, Showing Transitions between Instrumental Timbres.**

Example 4. *Adagio*, **Measures 66-73, Brass, Showing Timbral Transitions and Dovetailing.**

Example 5. *Adagio*, **Measures 29-33, Showing "Jazz-band Hits" in the Trumpet Parts.**

Based on my experience, works in a spectral idiom can serve as an excellent pedagogical tool for the performance and appreciation of new music in general. The very lack of familiarity that students have with the idiom can serve as an advantage, as the students are forced not to take for granted elements of harmony, rhythm, and orchestration to which they are accustomed. At the same time, spectral music is not as intimidating as, for example, serial or post-serial music, or as radical in its rejection of received norms as much aleatoric or highly experimental music. The kinship between my work and certain types of popular electronic music was also noted by several students.

Finally, I would like to encourage fellow composers to work with secondary school musicians. While I would strongly discourage the sort of facile populism common among some composers, the problem of the future audience is one that every composer eventually must face. While very few high school student musicians go on to careers as professional performers, many retain a lifelong interest in music and become avid concertgoers. Moreover, these students, for whom music-making still retains much of the feeling of adventure which so many professionals have lost, are often far more open-minded and open-eared than their professional, or even collegiate counterparts. These students need challenging repertoire that will stimulate them musically and intellectually, as well as encouraging their interest in new music.

MUSIC INSIDE OUT:
SPECTRAL MUSIC'S CHORDS OF "NATURE"

Tildy Bayar

The construction of the natural is a venerable tradition among Western composers and musical thinkers.[46] A compelling site for examination is that point at which technology first enabled the presence of mimetic, rather than metaphoric, natural phenomena in music. The intersection of metaphoric natural space constructed through compositional artifice and re-presented natural space constructed in the process of technological interface, may be located at a 1924 concert at the Teatro Augusteo in Rome. During the concert, composer Ottorino Respighi played, at the end of the third movement of his *Pini di Roma*, a recording of a warbling nightingale. Prior to this innovation (loudly booed by the Roman audience), European music was implicitly circumscribed, and thus defined, in opposition to its "other," natural sound. Earlier experiments such as the Futurists' *intonarumori* also problematized this received music/sound binary. The Futurists employed sounds as new musical materials, which expanded the metaphoric esthetic but failed to break free of its compass, bringing "noises" into music but leaving the European **idea** of music essentially intact. Conversely, Respighi's nightingale, re-presented but unremediated,[47] retained a mimetic character that noticeably failed to blend with the metaphoric, and thus suggested possibilities for a refiguration of the essence of music. The nightingale was the first musicalized sound to manifest the double identity of self and self-reference, which it shares with hip-hop song samples, while the

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[46] [Although we accepted Tildy Bayar's paper for the conference, she was not able to attend.]

[47] In the process of "remediation," something is adapted from its form in one medium in order to make sense in another; e.g., a stage play is adapted for television. Jay Bolter and R. Grusin (2000) propose that all media co-construct each other and are always in dialogue with each other; and that reality and mediation are inseparable, as all mediations are as real as any artifact in a society.

Futurists' remediative practices deleted their sound materials' referential aspects.

Four decades later, after the barrier between sound and music had been irretrievably demolished by John Cage's rejection of the narrative, historical, and social meanings of sounds (what Douglas Kahn calls the "sociality of sound"[48]), a North American compositional Zeitgeist arose which straddled the line between the divided realms of metaphor and mimesis. Composers such as Steve Reich, Terry Riley, Alvin Lucier, James Tenney, Pauline Oliveros, David Dunn, and Annea Lockwood expanded the idea of "natural" to include organic **processes**. Their image of nature was mediated by science and the viewpoint afforded by technology; their interests were in music as phenomenon, and in phenomena "as themselves." The early spectral music of the l'Itinéraire composers, developing at the same time in France, shares many fundamental assumptions with this phenomenological school, but also differs in important ways.

Appeals to "the natural" as justification for particular compositional choices also constitute a venerable tradition in Western music. Notably in the 20th century, composers such as Edgard Varèse, Olivier Messiaen, Iannis Xenakis, Henry Cowell, Harry Partch, and Lou Harrison justified their predilections for certain musical materials on the basis of those materials' ubiquitous occurrences in sound forms which were not compositionally mediated. These composers often played a complex game with nature, invoking it in order to shore up aesthetic foundations that were felt to be in need of reinforcement. Occasionally they employed the idea of nature as a device through which (more or less essentialized) non-European musics were represented in a Western context. These uses of "nature" point to the troublesome dynamic between **is** (in a given context) and **should be** (in another), which to be adequately addressed would require an analytical framework outside the scope of this paper. Yet the intuition reflected by the ubiquity of this dynamic in writings about music may tell us much about the relations between sounds and their contexts.

Can we hear natural sound in music? That is, can we hear sounds "as themselves" when they are no longer themselves, having been transplanted into (and thus transformed by) a musical context? Do we hear the sounds of the rain on the roof during a reverential string quartet performance of *4'33"* as natural, as musical, or as something ontologically in between? What

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[48] In *Noise, Water, Meat: A History of Sound in the Arts*, Kahn (1999) distinguishes the sociality—the historical (p. 1) and "the political, poetical, and ecological" (p. 4)—from the materiality and aurality of sound.

about Respighi's nightingale, which sounds so obviously "other" in relation to its metaphoric-musical context? Can we hear its recorded, recontextualized song as it would sound to us in the forest?

We may interrogate assertions by John Cage (and others) that it is possible to hear sounds "as themselves" in a musical context by illuminating the underlying perceptual-psychic-social complex which constitutes the listening experience. "Sound" as a heard phenomenon is invariably mediated by interpretation; and the sonic components of a musical experience (if the experience **is** musical, and not simply sound-locational or sound-identificational) do not constitute its generative materials, but are rather produced by its (compositional and interpretive) imaginative artifices.[49] Attempts to distinguish "sounds in music" from "music" are confusions based on more fundamental confusions about sounds' ontological status, as evidenced by Tristan Murail's notion that sounds have an "acoustic reality and a perceptual reality" (Malherbe 2000: 18). It would be more accurate to state that sounds have a system-dependent identity when modeled by physics; and that **acoustically** sounds are modeled by the human ear and the human brain. J.K. Randall's assertion (2003: 145) that the "sounds" used in music perception experiments assume the ontological status of "bad compositions" when organized, supports the view that the effect of compositional context on constitutive material is total(izing), even when the metaphoric identity of a material component suggests that it is merely "sound." Music based in "natural sound" proposes an expansion of compositional technique to encompass the metaphorical (re)construction of the natural, rather than a reconception of the compositional context as neutral.

Spectral music's relations with "natural" sonic properties are especially illuminating. Spectral composers Tristan Murail, Gérard Grisey, and Jonathan Harvey have not purported to delete compositional contexts from their music, far from it. They have claimed, however, to organize music in accordance with the ways we naturally perceive sounds, and to produce perceptible results along these lines. My phrasing here is deliberate: a distinction between "naturally perceiving sounds" and "perceiving natural sounds" is more than merely semantic, as it situates the spectralists' interests in the realm of physics-derived, rather than in aurally-dependent, acoustical properties. Yet spectral composers' views of music consistently refer to nature, as well as to notions of direct, unmediated perception of acoustic phenomena. The perceptual-psychic-social complex underlying their music

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[49] This idea comes from Boretz 2003 [1970].

is worth examining critically, in order to uncover the (discursive and compositional) relations between these composers' sonic materials, compositional activities, and musical results. The ways in which its proponents have conceived of spectral music reflect a confusion at the root of its esthetic between the bipolarities of mimesis and metaphor (and thus between revolution and tradition). This music is deeply ambiguous regarding what it wants to communicate: a metaphorical image of the natural (which anyway is inside-out in its refiguration of nature as its technologically-mediated image), or a direct, literal representation of sonic properties and acoustic phenomena.

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Early spectral composers were especially concerned that music be viewed as "a special instance of the general phenomenon of sound," and as "sound evolving in time" (Fineberg 2000: 2). More radically than Cage's introduction of "sounds" into music (which suggested possibilities for listening to sounds from the perceptual location reserved for music), this insistence that music is, ontologically, **sound** refigures the very heart of music as its hitherto-other. If music is sound, we must listen to it with the same perceptual orientation we use to listen to sounds in a non-musical context.

W. Luke Windsor (1997: 79), writing about electro-acoustic music, says that

> Listeners do make sense of the least conventionally structured … works, and I would argue that they do so in two ways, and that these two ways reflect general properties of human perception. First, listeners interpret sounds in terms of known environmental sources, be these "musical" or "everyday." [Windsor argues elsewhere that this binary opposition is spurious.] This is not just a case of listeners **imposing** structure upon their auditory surroundings; a mutual relationship exists between listener and environment such that acoustic structures, whether temporal or frequency based, may specify certain excitatory sources, or more general provenance, and the listener explores these acoustic structures in such a way as to construct a meaningful interpretation based upon this information. Listening to music is a search for meaning, and this search is constrained by our familiarity with the physical and cultural invariances of the world.

Windsor proposes a refiguration of music that offers several implications for the spectralists' ideas. His idea of music is involved at a definitional level with sound source identification. This notion of musical meaning opens valences between ideas of sound structure and musical structure,

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bringing them both into play simultaneously in any listening experience: when listening to music we're listening for sound sources; when listening to sounds we're "constructing meaningful interpretations," i.e. organizing hierarchically or **composing our sonic environment**. In Windsor's view, sound is always mimetic and music contains a fundamental mimetic element; "interpretation" (usually the domain of the metaphoric) serves mimesis. If music is a special case of the general phenomenon of sound, our listening must emphasize the mimetic rather than the metaphorical.

Benjamin Boretz (2003: 390) proposes an opposing idea of the relation between music, sound, and perceptual orientation:

> … does a musical image incandesce because it flashes forth by a twinkle of surface the full depth of the pool of reference on which it floats?   Floats: the twinkle is the depth's edge, ultimately depthlimiting. Twinkle at poolbottom, and there will be only flat bottom perceived; but twinkle at top, and there is a pool to float over felt, surface, depth, bottom, all together. So the experience of riches of musical depth comes by way of the acuity not the complexity of the musical surface; all is conveyed by the explicit sparkle of that twinkle: high atop a deep or boiling or tranquil or shoalfilled current; or just a map of the bottom of something or other. … And if the texture datasaturates,   repletes   unto   itself,   color   neutralizes,   drains: demorphizes. If the reference **is** the surface, then the incandescence never glows.

Boretz's "musical image" takes metaphor as a defining quality for music. If musical surface is identical with musical structure (as in an unremediated re-presentation of acoustic phenomena), there can be no metaphoric imagery. Boretz's idea implies that the unremediated insertion of the natural into a compositional context will not create metaphoric resonance, but rather will contribute only flat "data of surface." A music based on "natural sound" would not figure, within this idea, as music; the sound itself would not figure as anything **but** music.

In many of Tristan Murail's early spectral pieces "the form was identical to the structure of the sound"; in Gérard Grisey's early music "the form itself recounts the history of the sounds of which it is made" (Castanet 2000: 31). Because of the temporal distortion in these pieces from short sound slice to concert-length work, and the change in context which turned primarily mimetic (locational, identificational) listening to primarily metaphoric (expressive, productive) listening, sound structure becomes refigured as musical structure. Does this new structure retain an aura of the original sound structure? Many spectral composers appear to believe that it does.

Boretz's idea could imply that the sound structure is actually a miniaturized musical structure, but this does not suggest that a correlation between the two is preserved after the former is recontextualized. Is the relationship between sound structure and musical structure in early spectral music mimetic or metaphoric?

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L'Itineraire composers' notions of sound, based in physics and suggested by technological processes, imply that the harmonic spectrum is the essential element necessary to preserve a meaningful sense of "a sound" after its remediation from a natural to a musical context. Like physicians x-raying a patient, these composers analytically distilled a slice of sonic experience that they believed contained crucial information about the sound's meaning **as sound**; they then transposed this sonic slice into a newly composed piece. This remediative process may point to the genesis of the confusions with which we are concerned. Spectral analysis, as a precompositional process, becomes confused with the audible results of its results' remediation.

Spectral music is sometimes described as though the listener were a participant in a music perception experiment, the aim of which is to discover whether a preserved auditory principle (in the spectral case, the mimetic implications of the relations between partials) will function audibly under new conditions.   The North American phenomenological school has produced many pieces that might be described in this way; e.g., Steve Reich's *Come Out* (1966), Alvin Lucier's *I Am Sitting in a Room* (1969), and James Tenney's *Critical Band* (1988). These compositions conflate auditory principle and musical context, existing ontologically in a border region between "piece" and "experiment." The expressive content of, for example, *Critical Band* is **data**; all other parameters, including the traditionally expressive dimensions (articulation, volume) function as background texture. This extreme reduction in context produces music that is clearly mimetic. But where data is presented within a **metaphoric** framework, as in much spectral music, does the preserved auditory principle still function?

PARTIELS

As the results of being x-rayed fail to describe how a person is perceived by other people in everyday life, the results of spectral analysis (particularly steady-state spectra without attack transients) fail to describe how a sound is perceived by people in a non-musical context. So, in what sense can what is communicated by a remediated trombone spectrum in a piece like Grisey's *Partiels* (1975) be said to be "about" the original sound?

<div align="center">112</div>

Partiels has been described as an exploration of the sound of a trombone. The sense in which it is the "sound" of a trombone that is explored deserves scrutiny. What could be less natural than taking the results of a computer analysis of the spectrum of an instrument (already a technological creature the sound of which bears little relation to anything found in nature) and orchestrating them for different instruments to play in a new composition? Should the remediated resonances evoke trombone-ness? If the preserved auditory principle does function mimetically, it does so in the service of *Partiels*' sheer metaphoric perversity—trombone resonance emanating from other instruments in a kind of sonic transvestitism—which positions the piece squarely atop the line between reproduction and evocation. (Windsor's refiguration of music seems particularly applicable to *Partiels*, as listeners seem intuitively interested in the idea that they're hearing "the sound of a trombone.") If the preserved principle fails to function, however, the original trombone is employed simply as a source of compositional material.

Grisey has written about *Espaces acoustiques*, the cycle of six pieces of which *Partiels* is the second, that in retrospect it seems to be a "giant laboratory where spectral techniques are applied to diverse situations. Some of the pieces even have a demonstrative aspect, almost didactic" (Malherbe 2000: 24). Grisey's didacticism in *Partiels* is similar to James Tenney's in *Critical Band,* in that both composers want to tune the listener's ears to finer pitch gradations than are normally heard. But Grisey's rhetorical stance is recognizably compositional, and thus *Partiels* is more traditionally musical than is *Critical Band*, and its didacticism remains somewhat hidden. While the expressive content of *Critical Band* is data, *Partiels*' expressive content is ambiguous, eliding the traditionally hierarchized regions of texture and rhetoric. Its guiding metaphor seems to be the aesthetic/sensual appreciation of sound quality; in this sense, the piece represents a return to a classical sensibility.

ADVAYA

Jonathan Harvey's *Advaya* (1994) employs a complex and multilayered process of remediation. The harmonic series (perhaps the most widely used trope of nature in Western music), in the character of an A220 played on a cello, is analyzed and resynthesized with alterations to the spectrum, and then recombined with unaltered and live-processed cello sounds. The original cello sound functions in the piece as a metaphor for (the purity and simplicity of) nature; the spectrally altered sounds offer, as binary contrast,

an artificial harmonic world and sonic character. The cello sound is presented as central and (harmonically) pure, the modified sounds as intrusive, grungy, and out of tune; but gradually the cello is drawn into the modified harmonic world through a series of modulations between spectra around pivotal partials. The result for the listener is not a re-tuning of the cello so much as a dis-tuning of the entire world of the piece, so that finally the original in-tune sounds, re-presented, sound just as out-of-tune as does everything else. The binary relation established at first between the natural and the artificial is deconstructed in unexpected ways: each domain is gradually suffused with the other, and the overall effect is one of ambiguity and lack of resolution.

Describing his process in composing *Advaya*, Harvey asserts that "the natural [harmonic] series is equivalent to the tonic in tonality: any child can hear it" (Harvey 2000: 12). The issue of whether "any child" can hear the tonic in tonality should probably be left for a wider discussion; but while the harmonic series as the coloration of any particular sound is hearable by an untrained child, **as a musical parameter** it may only be heard as constrained by the context of its representation. Boretz's figuration of music as primarily metaphoric suggests that if, in *Advaya*, the material of the harmonic series sounds "natural," it is not because of any innate properties inherent in the source material, but because the composer has successfully used this material to create the "nature" image. When recontextualized, the source material is subordinate to its context; it fully inhabits the realm of the metaphoric. In a complex relation to the mimetic, *Advaya* offers a contrast between live and processed cello, wherein the live instrument metaphorically represents its unadorned self.

Harvey writes (of a different piece, but this is also true for this listener of *Advaya*) that "it was curious that one easily lost the sense of spectrum in the discourse's melody and polyphony" (Harvey 2000: 13). In *Advaya* the detuned sounds don't convey a relation to the original cello spectrum; instead they emanate from a distinctly "other" harmonic space. Harvey's observation reflects a confusion similar to Murail's, who observes that a certain piece "is not really spectral, as there are no spectra in it," and reflects elsewhere that he has "often seen [his] pieces make more impact on the public through their form than as a result of their harmonic or timbral refinement" (Murail 2000: 7). While a piece with no spectra in it is clearly an acoustical impossibility, these statements reflect spectral composers' belief that the results of spectral analysis should retain coherence and mimetic meaning when transposed into new musical contexts. With Boretz, we might assert that "the sense of spectrum" must be a metaphoric rather

than a mimetic one (as must "the sense of" anything in music); if not foregrounded by compositional artifice, spectra will be perceived as merely texture. With Windsor, we might grant texture a more crucial role in creating musical meaning.

L'ESPRIT DES DUNES

Tristan Murail's *L'Esprit des dunes* re-presents sampled sounds as more or less transformed images of themselves, retaining a greater or lesser resemblance to their original forms. When processing his samples Murail preserved chaotic aspects of their frequency behavior; he described this process as having "kept some of the internal life of the sound"[50] (quoted in Smith 2000: 14). He hypothesized that these aspects' transposition to the electronic domain would produce easily heard correspondences between "natural" and electronic sounds, addressing the difficulty of preserving the meaningfulness of spectral information after remediation.

As in *Advaya*, the less-manipulated sampled sounds in *L'Esprit des dunes* are employed metaphorically, to evoke resonances of their original contexts, in contrast to the electronic domain (where transformation has deleted this referential aspect). These sounds, and by extension their original contexts, are thus essentialized as static images, frozen moments in "natural time"; they are also essentialized as stereotypically representative of the realm of the natural. This reductive image of a binary nature-technology duality obscures the complex world of representation offered by the temporal processes of the piece; thus, the metaphoric level works against Murail's attempts to forge a mimetic internal commonality between sampled and processed sounds.

Murail describes "tuning" the sampled sounds (by spectral modification in resynthesis) "to the harmonics of the music rather than using the sounds to create harmony" (Smith 2000: 19). That is, he composed the materials (rather than composing **with** the materials) to fit the context. This practice inverts the usual electro-acoustic approach wherein live or recorded

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[50] The full quote from Murail reads: "In [*L'Esprit des dunes*], I introduced some compositional elements in the resynthesis of the sound, although I kept some of the internal life of the sound. Acoustic sounds have a natural life in which the frequencies can be understood as behaving in ways that could be described as chaotic. It is that property, in fact, that is very hard to simulate with synthesis. Even if one uses models and then alters the sounds drastically, by keeping the chaotic behavior, the electronics and the instruments can communicate more easily (since the electronic sounds act a little bit like acoustic sounds)."

materials are given new meanings through recontextualization; Murail instead transposes contextual meaning **from the piece to the sound**. Murail's is a much more invasive approach to "sound" than that presented by cutting and splicing, which rearranges the surface contours of the source's trajectory but leaves its vitals intact, as it were. Murail's practice may be seen to embody spectralists' attitudes toward nature: their stance on the necessity for spectral integrity is equivocal, yet they'd like to retain the spectrum as a marker of the natural realm. The sense in which a "re-tuned" sound may be said to be "natural" is not unlike that in which Alba the fluorescent rabbit[51] is "natural": i.e., ambiguous at best.

In Murail's view, *L'Esprit des dunes* embodies several esthetics: that of "clear research on the level of pure technology" (Murail 2000: 9) and that of a compositionally transformative approach to materials. But the research esthetic seems to inhere purely in precompositional activities, its significance reduced to vague resonances in the musical domain. Grisey's "recurring dream of an art-science" (Grisey 2000: 2) might better be exemplified by a piece such as *Critical Band*, which eschews the metaphoric dimension, than by *L'Esprit des dunes*.

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We have seen that spectral music is fundamentally ambiguous in its desire to communicate both a metaphorical image of the natural (which we have shown to be inside-out in its refiguration of nature as its technologically-mediated image), and a direct, literal representation of acoustic phenomena. We have seen that this music's focus on the metaphoric dimension has tended to background its mimetic aspects, and thus its composers have failed to transform the acoustic properties of sound sources into communicable musical properties.

We have seen that the remediation of sounds into a musical context causes us to perceive them as music. As we listen to music, its "structure" **is,** ontologically, the way each "sound" sounds at each successive moment; any abstract model is constructed after the fact. Although we may listen for sound sources as we construct musical meaning, context is totalizing. The metaphoric dimension, unless backgrounded by compositional artifice, is the primary site for meaning-constructing activity. Hearing music as sound

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[51] Alba was created in 2000 by artist Eduardo Kac and French genetic researchers, who spliced jellyfish genes with her own. When placed under a black light, Alba glows fluorescent green. (http://www.ekac.org/gfpbunny.html#gfpbunnyanchor)

evolving in time invokes the metaphoric, rather than the mimetic; and thus fails to offer a refiguration of music.

Rather than hearing musical structure as sound, we have seen that spectral composers hear sound structures as music, a relationship which might (humorously) be described as compositional imperialism rather than Cageian *laissez-faire*. Spectralists' relation to the natural resembles that of Las Vegas Nature Experience™ resort developers rather than conservationists; or perhaps that of Marie Antoinette and her ladies, in relation to the shepherdesses at which they played. The eventual resort will offer what purports to be a fully self-contained reproduction of the natural (which could be experienced in its unremediated state simply by stepping out of doors), yet nothing about it will be at all natural; while the ladies of the court will concern themselves with choosing and reproducing the particular natural qualities which would most compellingly amplify the charms they already possessed. Each of these dynamics is at work at the root of the self-contradictory esthetic of spectral music.

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THE IMPLICITNESS OF TIMBRE:
ATTITUDES TOWARDS TIMBRE IN BARUNDIAN AND WESTERN ART MUSICS

Cornelia Fales

Twenty years ago, when I first began studying musical noise and other timbres in African music, only a few composers and psychoacousticians were really looking at timbre in any substantive way. More recently, the subject of "sound" has become trendy on a popular level, so much so, in fact, that the 1990s were broadly proclaimed the "decade of sound." Social theorists highlighted the growing interest in movements like vibration and sound therapy, spiritual resonance groups, sound theory, and soundscape ecology—all as evidence of the unprecedented aurality of modern life. Of course, there was a good deal of imprecision in this proclamation, since it was not really sound or aurality that distinguished the decade—after all, previous decades had had both—but rather the kind of sound that was new and the kind of aurality that attended to it. What seemed to have changed dramatically in both musical and nonmusical sound was not so much the range or pattern of pitches, rhythmic patterns, or dynamic variation; rather, it was the kinds and arrangements of timbres in the new sounds.

I would agree, though, that there seems to be a growing sensitivity on the part of ordinary listeners to timbre, thanks in part to the ubiquity of electronically created sound in the popular domain. But there are certain aspects of the relationship between listeners and sound that have not changed—and some of those are what I want to talk about today. I want to contrast in large generalities, the attitudes and uses to which timbre is put in two broadly different cultures: the historical institution of Western art music on one hand, and music as it exists and is assumed to have always existed in certain African cultures on the other. To make the contrast even more pronounced, I will limit my discussion to African **traditional** music, which I define somewhat arbitrarily as music produced on acoustic instruments, normally without electronic mediation of any kind. I am going to start with Western music, and to do that I want to back up to the writings of the French

119

philosophes in the first half of the 18th century, an era during which many of the explicit ideas about timbre that condition our attitudes today were first beginning to develop.

Even before that—as early as the 12th century, in fact—the translator Dominicus Gundissalinus complained that there were no words to designate differences in sound quality; different sounds "had no names of their own," but were described by analogy with other senses (Burnett 1991). That there is no language to describe timbre is a fact of many languages, but one that Gundissalinus would probably not have noticed, if not for his professional regard for lexical precision. At the very end of the 17th century, one finds what appears to be the first recorded attempt in Western literature to separate out the parameter of timbre for examination. In 1699, the artist and geometer Philippe de la Hire tried to alert the scientific community investigating acoustics that there was a dimension to sound that they were overlooking. "One must distinguish," he said, "the sound which is formed by the encounter of two sonorous bodies which clash from the pitch that it [the sound] has in comparison to another pitch of the same nature." De la Hire's problem was that he was trying to describe a sensation for which he had experiential evidence but no descriptive vocabulary. Given the grammatical and terminological muddle of this statement[52] and the rest of the treatise that it introduces, it is no wonder that he made little headway in trying to convert his fellow listeners into some sort of timbre awareness. As the treatise progresses, it becomes apparent that even de la Hire is not quite sure—perceptually or conceptually—what he is talking about.

What is interesting about the 18th century is the intensity with which listeners and theorists became aware of and then obsessed with harmonic overtones, beginning at the end of the Scientific Revolution and onward for almost a century and a half. Since overtones are the raw ingredients of timbre, it is intriguing to a timbre specialist that these "delicate sounds," as they were called, captured the ears and imagination of the 17th and 18th centuries in the form of pitch, rather than in their contribution to timbre. Given the remarkable advances in what we now call physics and acoustics during the first half of the 18th century, it is curious that no one realized the connection between overtones and timbre. The possibility that multiple

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[52] In case you think theirs was a problem unique to the 18th century, consider the often-quoted official definition of timbre as given by the American National Standards Institute: timbre is "that attribute of a sound by which a listener judges that two sounds of the same loudness and pitch are dissimilar" (ANSI, 1973). This view sounds a little like de la Hire's.

harmonics might perceptually fuse into the sensation of timbre seems no more strenuous a leap than other discoveries of the era, the principle of superposition, for example. Furthermore, a process in the visual domain analogous to the auditory blending of harmonics into timbre had been established in Sir Isaac Newton's *Opticks*, in which he showed primary colors—he claimed there were seven of them, which caused confusion later—to be the basic constituents of all other, more complex colors.

In addition to de la Hire's treatise, 18th-century French writings on music are full of what I call "near-miss" descriptions of one aspect of music or another, often prompting the suspicion that their authors were actually hearing timbre, though describing something else, usually pitch or loudness. Typically, these occur in discussions entailing the concept of the *corps sonore*, the vibrating body, the source of all sound vibrations. The *corps sonore* was the physical phenomenon whose mathematical regularity provided so many solutions to the theoretical problems of Jean-Philippe Rameau; it also, by the end of his life, began to take on a kind of spiritual dimension as Rameau transformed it conceptually into a kind of mystical source of all things aesthetic, mathematical, and scientific. Most notably, the *corps sonore* produced the all-important harmonic overtones, discussion of which took 18th-century scientists and philosophers along paths of inquiry that went over and around—and in some cases, very close to—the phenomenon of timbre. Throughout the 18th century, one finds numerous situations where it is difficult to believe that the authors could have missed the connection between overtones and timbre. For example, in the "S" Volume of Denis Diderot's famous *Encyclopédie*, Jean-Jacques Rousseau includes a short paragraph on the mysteries of *tymbre* in his article on "sound." He says:

> As for the difference that is found between sounds by the quality of timbre, it is evident that it results neither from the degree of lowness [pitch], nor even from that of loudness. Even if you put an oboe exactly in unison with a flute, and reduce the sound to the same degree, the sound of the flute will always have *je ne sais quoi* of softness and mellowness, that of the oboe *je ne sais quoi* of dryness and bitterness, which prevents one from ever confusing them. However, no one that I know has ever examined this troublesome part [timbre]: for the quality of timbre depends neither on the number of vibrations that make the degree of high or low, nor on the largeness or the force of these same vibrations, which makes the degree of loud, or soft. We must therefore find in the *corps sonore* a third modification

different from these two to explain this last property; a project that doesn't seem to me will be very easy. (Diderot 1751, Vol. 15: 345)

In the very same volume, Diderot devotes part of his article on sensations to Locke's concept of clear and confused sensation, using both color and sound as examples. Just as Newton discovered the role of composite colors, Diderot observes, so the 18th century has discovered the role of overtones in sound.

It is the same with tones in music. Two or several tones of a certain kind coming to hit the ear at the same time, produce a chord: a fine ear perceives these different tones together, without distinguishing them well; they unite together and melt together in one another; it is not properly any of these two tones that one hears; it is an agreeable mix which is made of the two, from which results a third sensation which is called chord, symphony: a man who will have never heard these tones separately, will take the sensation which results from their chord for a simple perception. This will not be true, however. … All sensation, however indivisible it seems to us, is a composite of ideas, an assemblage or mass of little perceptions that follow in our souls so rapidly and of which each is stopped so little, or which is presented there at once in so great a number, that the soul, unable to distinguish one from the other, has of this composite only a single, very confused perception. (Diderot 1751, Vol. 15: 307)

What are we to make of two articles in the same *Encyclopédie* volume—neither of which present material unknown to the author of the other—together describing the perceived and acoustic aspects of timbre, with no recognition whatsoever that both are discussing the same phenomenon?

As documented by the *Dictionnaire de l'Académie Française*, the word "timbre" underwent multiple historical transformations before approaching the definition currently in use. Until the end of the 17th century, *tymbre* designated a clapper-less bell that was struck from the outside with a hammer, like the bell on an alarm clock (1694, Vol. 2: 563). By the fifth edition of the *Dictionnaire* at the end of the 18th century, it retained the meaning of bell, but also referred to the sound that the bell makes, as well as to the resonance of a human voice. In this latter usage, a voice was capable of various timbres, or none at all if it were without a pleasing resonance (1798, Vol. 2: 658). Not even the sixth edition, published in 1835, referred to the abstract sense of timbre as "tone quality" (1854, Vol. 2: 844). As we saw earlier, however, by the time of the "S" volume of the *Encyclopédie*, published in late 1765, the term "timbre" began to appear in its modern sense. Both the "T" volume of the *Encyclopédie* and Rousseau's

Dictionnaire included his articles on *tymbre,* where it was defined as "that quality of sound by which it is sharp or sweet, soft or crashing." The two articles were identical, except that the *Dictionnaire* noted in addition that it had this meaning only "by metaphor," presumably referring to its original meaning of "bell." William Waring's English translation (1779) of Rousseau's *Dictionnaire* left the term out altogether.

In addition to lacking words for timbre, 18th-century French vocabulary was woefully inexact regarding **all** the parameters of sound. For example, throughout the century, the three words *ton* (which we would translate now as tone or pitch), *son* (sound), and *bruit* (noise) had overlapping and ambiguous usage: *ton* could mean pitch or interval, *son* could mean tone or sound, and *bruit* could mean sound or noise. The word for harmonic was equally often *ton* or *son*, and both words designated a pitched sound. A similar linguistic confusion was created by the use of the word *harmonique* to refer variously to: 1) an individual component or single tone of a consonant chord; 2) an individual component or overtone of a timbred tone; or 3) the pitch produced by a proportional division of a string or other vibrating column as determined by a relevant harmonic ratio. Even when the term translated as "harmonic" as we understand it, a collection of harmonic overtones was referred to most frequently as a *chord*.

Compounding this confusion was the use of the word *fondamental*, first coined by Marin Mersenne to refer to what he called variously the "*ton naturel*" or "*son naturel*," the lowest of a series of harmonics whose pitch corresponds to the global pitch of the entire timbred tone. Joseph Sauveur used the same definition, and thus was erroneously credited with our modern term "fundamental frequency." But having established that definition in his *Mémoires*, Sauveur then used the same term to label the pitch standard he proposed as a means to ensure universally consistent tuning: "… we take the *son fondamental* to be the fixed sound, which makes 100 vibrations in a second of time, of which I spoke above." Finally, he used the term as the lowest of any simultaneous tones: "I call the *son harmonique* of a *son fondamental*, that which makes several vibrations while the fundamental sound makes only one" (303). Rousseau defined *son fondamental* ambiguously as "the one which serves as the basis of a chord" (387). In all of these variously confused terms, only the word *bruit* existed without specific connotations of pitch.

The interchangeable use of these terms implies the conflation of two consecutive levels in the hierarchy of gestalts that defines auditory perception. To the extent that *fondamental* was either the lowest harmonic of a timbred tone or the lowest note of a chord, *harmonique* applied either to

a timbral or chordal component, and a collection of harmonically related frequencies was considered *harmonie naturelle* (nature's contribution to auditory aesthetics), listeners of the 18th century were expressing a conceptual if not a perceptual confusion between a chordal gestalt and the much tighter gestalt of a timbred tone. The idea of harmonics as part of nature's perfect harmony assigned the tone's "natural sound"—presumably its characteristic timbre—to the fundamental, while the upper harmonics sounded various pitches consonant with the natural sound; one can speculate that these higher pitches were assumed to demonstrate the same timbre as the natural sound.

If we assume the *Dictionnaire de l'Académie Française* to reflect more popular usage than the *Encyclopédie*, then throughout most of the 18th century there seems to have been no word in common parlance representing the concept of timbre.[53] But literature of the period suggests strongly that for listeners of the 18th century, more than just the **term** timbre was lacking. Indeed, historic documents recorded by otherwise careful listeners indicate that there was no term for timbre because there was **no conscious awareness of timbre** as a distinct parameter of sound.[54] Put another way, the problem of describing timbre was as much conceptual as it was lexical. Writers did not fail to discuss timbre for lack of a term to name it; rather, they lacked a term for timbre because they failed to conceive of it. If nothing else, support for this ordering of cause and effect is visible even in contemporary descriptions of sound, where listeners continue to overlook or mislabel timbre, though the necessary term has been securely established for several centuries. For example, listen to David Toop:

> An invention of our fast disappearing century, audio art is founded in the idea that sound (as opposed to pitch relationships and a harmonic system) can be the organizing principle of musical activity. … Sound has emotive, suggestive powers that can flourish when detached from music. (Toop 1998)

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[53] It has become commonplace to point out that most languages even now have little domain-specific terminology to describe timbre, that timbre is difficult to abstract into a describable system since it does not vary in a perceived order of increments, or that timbre is often difficult to separate perceptually from other parameters of sound.

[54] The only exceptions to the nearly total absence of references to timbre in this literature occur in tracts on instrument construction and pedagogy where vague imitative and metaphoric images attempt to describe the effects of faulty construction or improper performance technique.

And Brian Eno:

> One of the interesting things about pop music is that you can quite often identify a record from a fifth of a second of it. You hear the briefest snatch of sound and know, "Oh, that's 'Good Vibrations'," or whatever. A fact of almost any successful pop record is that its sound is more of a characteristic than its melody or its chord structure or anything else. The sound is the thing that you recognize. (Eno in Korner 1986: 76)

And Joan La Barbara:

> *Joan La Barbara*: I began to work with jazz musicians. I asked individual players to play long tones, and I would try to imitate the sounds, correcting after each attempt. Then I began working on the improvisational possibilities of the voice.
>
> *Interviewer*: When you say you were imitating the tones, do you mean the timbre or the pitch?
>
> *Joan La Barbara*: I was imitating the timbre. Of course, I was singing the same pitch. I discovered that the voice could do a lot of things I hadn't imagined it could do…. (Covert Culture interview series, 1996)

How amazing to hear well-known musicians, each intending to make a central point on the role of timbre in contemporary music, only to muffle the subject by choosing the more general term **sound**, from which they must then eliminate all features except the quality they mean to address. In La Barbara's interview, in fact, it is the interviewer who insists on precision. So the question becomes: why is timbre—one of three dominant parameters[55] of sound—so cloudy in concept and percept that listeners either misattribute or fail altogether to consciously register its variations? Why has this been true until the very recent past in Western music history, while pitch has been measured, systematized, tempered, and celebrated as the basis of an entire cosmology still strong in the neo-Pythagorean Enlightenment? I suggest that in the case of the 18th century, there are two primary factors that influenced attitudes toward musical timbre, one I claim to be inherent to timbre itself and the neuropsychology of its processing, and the other a product of the epistemological climate of the era.

The first requires a bit of background in recent research on modes of human perception. What I will propose here is that one explanation for the consistently greater emphasis on pitch and dynamics over timbre has to do with a major difference between the kind of processing that yields sensations

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[55] Or one of four dominant parameters, depending on the definition of parameter.

of pitch-height and loudness, and the kind of processing that results in the sensation of tone quality. Specifically, in a default context, timbre is an object of what is called implicit or unconscious perception, as distinct from the parameter of pitch, which, in the same context, is an object of explicit or conscious perception. Research of the last three or four decades in human cognition has been shaped by the cooperative efforts of behavioral- and neuro-psychologists whose techniques of brain imaging allow direct examination of the brain at work. Among the many discoveries that this combination has afforded is graphic evidence of neural response to stimuli that a subject is unaware of perceiving. The subject of implicit perception has become an important part of work in human perception and cognition, as researchers begin to understand the magnitude of sensory information that is subliminally perceived, interpreted, and responded to in the course of daily life.

But the field is still young, and many subtle distinctions between different states and degrees of consciousness have yet to be delineated in any precise, systematic way. In particular, current convention treats as comparable phenomena implicit perception whose content remains unconscious to the perceiver, and implicit perception whose content may become conscious spontaneously or with effort on the part of the perceiver. I point this out as a counter to arguments against the implicit perception of timbre on the grounds that musicians (among others) make a living from their ability to be conscious of timbre.

Let me be clear about exactly what I am proposing. Obviously, all unimpaired listeners hear and evaluate timbre acutely all the time: it is the parameter that arguably contains the most information about the source of a sound and the terrain through which the sound has traveled to the listener. Clearly, listeners are capable of **conscious** awareness of timbre; the processing that produces timbre is defined in part by the variable awareness with which its product is received. But we should not equate the distinction between conscious and unconscious awareness to ordinary states of heightened and reduced attention. Our intuitive sense that awareness requires a simple refocusing of attention—that even when our powers of concentration are otherwise employed, we can still monitor unattended timbre out of "the corner of the ears"—this bit of experiential common sense confuses variable awareness with degrees of attention. The variability that occurs in consciousness of timbre describes discrete, binary conditions—awareness is on or off—that may alternate over time, not a process that varies by degrees. It is not true that a listener to whom timbre is unconscious at a particular moment, hears it in the background of whatever

occupies his/her immediate attention; rather, the timbral quality of the sound and the information it conveys **do not exist** for the listener until it breaks through into his consciousness. We have all experienced this kind of sudden break through into consciousness. A typical example might take place as you are sitting at the kitchen table reading with such focused concentration that you are completely absorbed; suddenly, something pulls you out of your book and into your environment. You realize that the refrigerator has stopped humming; the sound that you have been monitoring without consciousness, has jerked you into conscious awareness of it by stopping suddenly. Until its change in status, the refrigerator hum did not exist in your perceived world, and if it had not stopped, you might have finished reading and left the kitchen, without ever knowing it contained a sound that you had been implicitly tracking.[56]

In part, failure to taxonomize types of consciousness (or unconsciousness) is due to a marked consistency in the characteristics, capacities, and limitations of unconscious processing occurring across apparently different states and degrees of consciousness. Until research begins to find systematic differences between what seem and feel to be distinct cognitive states, they will most likely continue as an undifferentiated category. Since conscious awareness is not necessary for perception and reaction, one might wonder what difference it makes to the larger musical experience whether timbre is implicitly or explicitly perceived. It turns out that our state of consciousness of the sound parameters that move us may make a considerable difference in the experience of music. Research indicates that the processing and effects of implicitly perceived stimuli are very different from the results of the same stimuli perceived explicitly. Implicit perception is not simply a less prominent or intense form of conscious perception; in fact, it appears that many of the functions performed by unconscious mechanisms are too complex, subtle, or transient to be assigned to the conscious mind, whose mode of operation is relatively lumbering and indecisive (for a review, see Reber 1993).[57] Two of the

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[56] In fact, one of the reasons that scientists have been late to discover the role of implicit perception in our daily activity is that unless something happens to bring a percept to consciousness, we may never become aware of it. The reflexive unconscious parts of our minds may be constantly alert, while we go about busy with other things, to sounds whose existence comes and goes as we implicitly register their characteristics for features requiring conscious attention.

[57] Implicit processes are generally specialized to specific tasks. Applied to these tasks, the unconscious mind is capable of parallel processing; it is faster, more

hallmark characteristics of implicitly perceived stimuli are reflected so predictably in timbre perceived in default mode that they serve to demystify some of the peculiarities of the parameter, while offering evidence that timbre is indeed implicitly perceived unless specifically called to conscious attention.

The first definitive characteristic of unconsciously processed information is referred to as "indirect measure sensitivity," describing the fact that implicit percepts cannot be directly examined or evaluated. On the other hand, implicit percepts may be indirectly accessed as a source of input to relevant problems or as a conditioning influence on the subsequent views or behavior of the perceiver. In the case of timbre perception, indirect measure sensitivity is evident in the tendency to neglect timbre as an independent parameter in direct description of music, while making fluent use of it to distinguish the instruments performing the music.

A second definitive characteristic is the tendency of perceivers to attribute the effects of implicit perception to a **conscious** phenomenon of outstanding perceptual salience. In a well-known early experiment by Kunst-Wilson and Zajonc (1980), subjects were exposed to subliminal pictures of colored geometric shapes, which they were unable to pick out in a subsequent test, as predicted by indirect measure sensitivity. When the same subjects were asked to choose from among several shapes those they found most attractive, however, not only did they most often choose the shapes they had been exposed to previously, but they also provided thorough, reasoned explanations for their choice, insisting on factors such as habitual proclivity for certain shapes, colors, symmetries, etc. Their very knowledge of themselves and of their own aesthetic habits was influenced by the need to explain a recently and unconsciously instilled partiality for specific tokens. Perhaps, then, we might see the overgeneralization or misattribution of timbral effects to other parameters of musical sound as a result of timbre's less than explicit perception to begin with.

If the defining properties of indirect measure sensitivity and misattribution serve to support the implicit nature of timbre perception, they also suggest the magnitude of power exercised by timbre in musical experience. For example, the influence of implicitly perceived stimuli has been shown to be thoroughly insensitive to contextual influence. Ordinarily, it is the conscious mind that tempers perceptual effects with contextual knowledge. With no communication between the conscious and

nimble, and more acutely sensitive to regularities in stimuli over time than the conscious mind.

unconscious parts of the mind, implicit processing cannot distinguish between metaphoric and literal, between vicarious and first-person experience, or between fiction and reality. The source of implicit percepts cannot be evaluated for reliability or intent, and the effects of implicit perception are always direct, personal, and powerful in their effect on a perceiver. In priming experiments designed to measure the influence of prior knowledge (the "prime") on the subsequent performance of subjects, a prime can be either conscious or unconscious in perception; the Kunst-Wilson/Zajonc experiment described above is an example of unconscious priming. Studies comparing the magnitude of influence produced by the same prime presented both explicitly and implicitly confirmed that the relative intensity and duration of affect was consistently greater when provoked implicitly rather than explicitly (Murphy and Zajonc 1993). In one experiment (Groeger 1988) where primes alternated between explicit and implicit presentation, subjects were specifically instructed to ignore the influence of a prime in performing a subsequent task. Results showed that subjects easily followed the instructions in trials preceded by explicit primes, but were unable to ignore the implicit primes, which affectively colored their subsequent performance. This discrepancy in results was supported by Magnetic Resonance Imaging (MRI) that confirmed that the implicit primes—but not the explicit primes—were able to produce the same strong neurological activity in the limbic system of subjects as occurs with real-life emotional experience.[58]

When characteristics such as those described above are extrapolated to the perception of timbre, they begin to explain something of the proverbial "ineffability" of music's power. At times when the parameter of timbre is implicitly perceived, not only does it provoke affective response more intensely than other parameters, but it does so covertly, beyond the conscious awareness of listeners. When the heroine in an opera fills an aria with her desolation at the loss of a child, the timbre of her voice may produce the same desolation in implicitly-perceiving listeners, who will later marvel at the profound depth of their emotion on behalf of a character who is fictional. Since the effects of timbre remain invisible to—hence

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[58] A more consequential form of this same experiment put subjects in a mock jury situation, where they were instructed to judge guilt on purely evidentiary bases. As jury members in this simulated courtroom, subjects proved to be frighteningly susceptible to implicit priming prior to the presentation of evidence in interpreting the facts of the case; in most cases, their final verdicts varied predictably according to the presentation-mode (implicit or explicit) of the primes they experienced.

uncontrollable by—listeners, they may attribute the strength of their response to the music's "haunting melody," for example, or its harmonic structure. In music of particularly powerful timbre effects, the implicitness of the power's source may explain some of the metaphysical qualities historically attached to music in many cultures. If nothing within the material limits of music can explain the power of music over listeners, it may not be unreasonable to consider its source in the music of the spheres, whose orbits reflect the harmonic ratios that regulate pitch and, it is worth noting, also constitute the raw materials of timbre.

Future research may find that the tendency of perceivers to misattribute the effects of implicit perception is important to the success of unconscious processing. Recall that a tone's timbre depends (in part) on the relative strength of the harmonic overtones that comprise its spectrum, and that the transformation of these overtones into the sensation of timbre is accomplished by means of a process called perceptual fusion. A crucial difference, therefore, between the parameter of timbre and the parameters of pitch and loudness is that timbre is a purely perceptual phenomenon, with no direct correspondence to the acoustic stimulus that provokes it, and no existence outside of a listener's mind. A source emits multiple frequencies, from which a perceiver hears a single, timbred tone. Thus, part of implicit timbre perception entails a modification of the acoustic world it represents. Now, an important priority in auditory processing is a transfer of knowledge from the environment to perceivers that is seamless enough to maintain their confidence that signals from the acoustic world literally are the percepts they provoke. We might call this the Perceptual Law of Seamless Reality, which decrees that listeners never suspect the existence of an acoustic world different from the perceived world of their senses. We can judge the survival value of the Seamless-Reality Law from documented instances in which the auditory system expends a considerable amount of energy for no other reason than to camouflage its own contributions to perception (Merikle and Daneman 1998). Since the unconscious nature of timbre constitutes a backgrounding of the very parameter where evidence of a discrepant acoustic world is most visible, one might propose a more robust statement of the Law of Seamless Reality: a deficit of information is better than a surplus that hints of multiple realities.

These considerations bring us back to the 18th century where, in trying to hear out the overtones of a timbred tone, the philosophers were busy refashioning their collective perceived world to mimic the acoustic world that inspired it. If you followed the progress in auditory research of the last twenty years or so, you are probably familiar with one of various versions of

gestalt-based theory that explains perception as the result of perceptual organization.[59] The standard demonstration of perceptual organization in the visual domain is a reversible figure-ground image, like Rubin's Goblet, that portrays two distinct and separate images, depending on how the lines in the drawing are perceptually configured. One of the important constants of perceptual organization is called the "Principle of Exclusive Allocation," which specifies that each line—each organizable component—can only be assigned to one grouping pattern at a time. The symmetrical lines in the center of Rubin's Goblet figure can be perceived as either the noses of the profiles or the indentations of the goblet stem, but not both at once. The formation of a timbral percept, according to this theory, is an exercise in perceptual organization, by which all harmonic overtones emitted by a single source must be identified and grouped together to be fused into the sensation of tone quality. Here is the major point of all this: in light of the Principle of Exclusive Allocation, the obsessive interest of the 18th century in **pitched** harmonic overtones amounted to an organizational choice. In the perceptual fusion that results in timbre, each overtone ceases to exist as a distinct percept as soon as it begins to contribute to tone quality; one cannot hear timbre and all its separately pitched overtones at the same time. The hearing out of overtones requires a reversal of perceptual fusion, a breaking apart of timbre, a rejection of the modifications normally imposed on acoustic reality by the mechanics of perception.

So it is not simply that a preoccupation with overtones led the *philosophes* to overlook timbre; rather, the effort to hear overtones and to convince others to hear them, amounted to a campaign against timbre. For Rameau, especially, it was a concerted movement to reject the perceived world of "lazy listening" in order to hear the acoustic world, for it was in that world that he found the pitches he needed to justify his theory of music. Whether they knew it or not, the emphasis of Rameau and friends on a pitched overtone series was a specific denial of the proverbial objective/subjective divide exemplified in timbre.

Now, the problem of epistemological dualism was neither conceptually nor empirically novel to the *philosophes*. By the 18th century, the issue had been around at least since Parmenides formulated the relationship between thought and existence. Less than twenty years before the first volume of Jean le Rond d'Alembert's *Encyclopédie* was published, René Descartes had given the problem its first modern formulation in the *Discourse on Method*;

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[59] The best known of these is Albert Bregman's theory of "auditory scene analysis" (Bregman 1994).

and Newton shortly before that had begun to develop the theoretical and mechanical apparatus able to examine the external world objectively and on its own terms. But it would be a mistake to confuse the scientific and intellectual manipulation of two worlds with the prospect of actually experiencing the disjuncture between the two. In his well-known metaphysical statement in the "Discours préliminaire" of the *Encyclopédie*, for example, d'Alembert takes a deliberately un-academic, informal, almost personal tone, as he points out that since we have no objective proof of a causal relationship between our percepts and the objects perceived, we must accept as signs of that relationship,

> the multiplicity of these sensations, the agreement that we notice in their evidence, the subtle differences that we observe in them, the involuntary response they make us experience, compared to the voluntary determination that governs our reflective ideas, and which we apply to these very same sensations. (d'Alembert 1751, Vol. 1: 2)

He observes, furthermore, that however unconfirmed our assumption that external objects exist as we perceive them, and are the cause of our perception, we are possessed of an instinctive confidence that we perceive correctly, an instinct that forces us to ignore the lack of empirical connection between percept and object perceived. About the existence of an external reality we cannot directly perceive, d'Alembert writes as though to sooth angst-filled readers, wrestling with the inherent uncertainty of the human condition. His position is typical of the ideas of the French *philosophes*; indeed, it was developed with almost word-for-word fidelity by Diderot, and Etienne Condillac as well used the same arguments in justifying the progress of his famous statue toward understanding of the world outside it. The argument is notable for describing a logically closed system that we will not unravel at the moment. The final exit from this problem, however, is an admonition. Whatever our skepticism, the fact is that we ought not to be concerned with truths that have so little to do with us:

> It is that which we must accept not knowing. It is to satisfy our needs and not our curiosity that we were given sensations; it is to make us know the relation that exterior beings have to ourselves, and not to make us know those beings in themselves. (d'Alembert 1751, Vol. 1: 46)

One might almost see an innate response to the Law of Seamless Reality in d'Alembert's metaphysics, so closely does his advice conform to the Law's dictates. Alternatively, perhaps his doctrine of obedient ignorance simply reflects the intellectual modesty fashionable at the time among scholars of sophistication and integrity. Whatever the inspiration for

d'Alembert's good-faith epistemology, his explanation, both in tone and substance, contains the seeds of the nearly apoplectic hostility that defined his association with Rameau in the latter years of the theorist's life.

Rameau and d'Alembert began their relationship in mutual admiration, but by temperament, they were very different, and after publishing a book together, they became notorious enemies. As pointed out earlier, each in his own way rejected the tenets of dualism. But d'Alembert's metaphysic was formal, conventional, and without real experiential basis:[60] from firmly within the perceived world, he argued that the imperceptible objective world had to conform to the evidence of his senses. As a music theorist, Rameau never intended a specific refutation of dualism; his mission simply required that he live an auditory life resisting the perceptual modifications inherent in default listening. If necessary for the validation of his theories, he was willing to experience the objective world by forcing his perception to present faithfully the acoustics it encountered. D'Alembert's arguments were logically sound, intellectually disinterested, and socially acceptable. Rameau, by contrast, was ultimately a social misfit, temperamental and reclusive; but his entire life's work inadvertently wrestled with the duality problem in a very personal way, and he left little evidence that he even appreciated the problem as it concerned him. For all his attempts at intellectual modesty, d'Alembert's solution to the subjective/objective divide was to insist that the acoustic world conform to his perception of it; Rameau's solution was to listen long and hard, until he overheard the acoustic world and called it Heaven.

There's much more than could be said about 18th-century theories of perception in regard to timbre, but I want to move on to Africa where we will find a very different situation. I will start by telling you two stories that come from my first field trip to Burundi, and both of them were instrumental in shaping the course my interests have taken since.

Here is the first story. Depending on what they have come to study, one of the first research tasks ethnomusicologists like to get out of the way is to pin down the music lingo of the people they are going to work with, so they can be sure they understand and make themselves understood. I had begun to work with a group of musicians living in the hills near the village of

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[60] It is notable, in fact, that considerable evidence suggests that d'Alembert was one of a number of Rameau's acquaintances whose ears lacked the acuity to actually hear overtones.

Muramvya. I had only been in Burundi about a month, and my Kirundi[61] was passable, but learnt from a book, and totally unspecialized for music, so I set about trying to get the terms I needed. At the time, I was a bit of an upstart, and I plunged right in looking for words that expressed my own take on music: what were the words for pitch, timbre, and loudness? What adjectives described a superior or inferior performance, and what qualities did those terms designate? What was the word for tuning, what about standard modal systems or common rhythmic riffs? These were questions about what seemed to me the basic building blocks of music, and yet they were met with blank faces or other signs that I was not understood. I decided that I was not asking my questions in the right way.

After a good several months of questions whose persistence probably established a reputation I never quite lived down, I went to a neighbor for help. Luckily enough, my neighbor taught music at the one *lycée* in Muramvya whose language of instruction is French. We talked about the problem in French for a while, and he agreed to come with me to help translate in pursuit of the terminology I needed. After a long session with several of the local musicians, the intriguing result was that not only did I **not** discover the terms I was looking for, but my neighbor seemed to lose his own facility with the terms—that we had discussed at length in French just the night before—as soon as he reverted to Kirundi.

By the time I came home a few years later, I had a word that meant "loudness," useful for saying things like, "the loudness of the women keeps the cows from sleeping." In addition, I had a list of words that **could** describe, but rarely did, a pitch that ascended rather than descended, but I never uncovered a Kirundi word for the abstract concept of pitch, much less a word for timbre; the same adjectives served to correct both parameters. I tried everything—I played around with it; in lessons I would respond to what seemed a pitch correction from my teacher, with a timbre change and vice versa. Instead of explaining why my response was wrong in words I could jot down in my notebook, however, my teacher would simply replay the phrase I had wrong, sing the note he wanted, or move my hands to the position that would produce the right pitch. As my language got better and better, I spent inordinate amounts of time just listening to the musicians talking to each other. I recorded everything everywhere, and stayed up nights transcribing passages that were fascinating, but never seemed to include the terms I wanted. Finally, I began to suspect that neither musicians

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[61] In current usage, the country is Burundi, the people are the Barundi (singular, Murundi), and they speak Kirundi.

nor listeners experienced a perceptual distinction between pitch and timbre. In the same way, for example, that flutists sometimes seem to hear flute timbre as a collection of pitches—they might say "your tone color has too much of the octave in it"—whereas others hear the same sound as a unitary tone that is too bright, I left believing that on a slightly higher level of fusion—and on the distinctly higher level of verbalized conception—the Barundi heard two parameters merged into one.

Over the course of two years living with the Barundi, I became convinced that the very idea of distinct parameters—pitch, timbre, and loudness—each varying independently along different dimensions, which is how we in the West theorize sound—that this notion is a purely cultural construction. It is true in fact, that research shows all parameters of sound to interact perceptually; for instance, increasing the loudness of certain sounds makes them sound higher in pitch. Why should not the possible variations in sound according to the Barundi entail undifferentiated changes in several or even all of the acoustic parameters that Western listeners identify—and actually hear—as individually co-varying? If this were true, then the vocabulary of a Burundi musician might contain only a single collection of adjectives to describe any deviation at all from the perceived correct sound. The musical tradition that encompassed the genre I went to study is orally transmitted, has never developed a systematic theory of composition, and rarely indulges in the kind of comparative exercise that looks abstractly at a "music culture" as a collection of coherent, definitive traits. Because learning took place by means of repetition and imitation, then all the distinctions that I wanted to make linguistically, a Burundi teacher would indicate by demonstration rather than discussion. Theoretically, a culture could function musically with one, all-inclusive term—for example, "wrong," "ugly sound," or even "change"—by which it pointed out any necessary correction, followed by more specific illustration.

I began to think in terms of a continuum of possible ways to interact with musical sound, beginning with a culture like the Barundi, whose traditional music is highly sophisticated in practice but basically a-theoretical in an explicit or abstract sense. Somewhere else on the continuum would be a culture whose music is also oral—that is, not notated, but which has developed an elaborate oral theory—as is the case for the panpipe music of the 'Are'are people of the Solomon Islands (Zemp 1979). At another point on the continuum might be a culture with notated music, but no tradition of music theory or abstraction other than the distinction of parameters to be notated. At yet another point would be a culture, such as the one described in the first half of this paper, with written music and an entire literature on

135

theory, developing along with changes in the music it describes. Each point along the continuum implies a different degree of externalization or abstraction of musical elements. A tradition of written theoretical analysis about specific aspects of music, of course, probably goes the furthest in separating and evaluating the functions of musical parameters over time. Clearly, notation alone involves a certain abstraction of parameters and often reveals patterns that might otherwise go unnoticed in practice. The important point of all this is that there is often a correspondence between degree of objectification and specification and the way in which the objectified and specified are perceived and understood. Alternatively, maybe the way to put it is that without the conceptual separation of parameters, there is no reason to think that a perceptual separation of parameters occurs. In an a-theoretical, oral tradition, whose method of passing that tradition through generations proceeds by demonstration and imitation, it is perfectly possible that the musicians play and teach their craft, and listeners appreciate and know good from bad performance, by a sort of unthinking gestalt-oriented instinct, without ever making a conscious distinction between pitch and timbre. Part of the difference between ideas about timbre in historical Western music and in cultures like some of those in Africa may amount to no more than where on the continuum the respective traditions are located. But of course, culture is never so simple, as we will see in my next story.

This story occurred after I had been in Burundi for about a year and a half. One day a man I will call Jonathan showed up unannounced in the little village where I was living up country. Jonathan was working in auditory cognition at Stanford University and had come to Africa to study perception among non-Western listeners. He had heard I was studying timbre, which was his special interest, and since apparently I knew my way around a bit, he thought he would come and work with me and "my musicians." Now this was 15 years ago, and at that time, ethnomusicology had certain conventions of political correctness, and in the first 10 minutes of our acquaintance Jonathan transgressed just about all of them. In particular, the whole idea of bringing psychological experiments into a field situation was anathema, conjuring up pictures of "natives" with electrodes attached to heads, etc. On the other hand, I am pretty tolerant: the poor guy was not trained as an anthropologist, he wanted to study timbre, and I have learned to mediate between blustering Americans and people they might offend.

Well, to make a long story short, he talked me into it, and we ended up testing 43 musicians. The test he had devised was really simple. Each "subject" was supposed to listen to 80 trials of five pairs of sounds, and in

each trial, identify which one of the five did not contain identical sounds. The non-identical pair contained sounds that differed in timbre by some degree, with all other parameters equal. All of the sounds were artificial, and most of the divergent pairs were subtle, differing by tiny increments, sometimes only a prominent harmonic or two. I had been a subject in lots of experiments before, and I knew how boring it could be. When I heard the sounds, I also realized that they would be so ugly to African ears, that only the most patient of musicians would sit through the whole thing. So I advised two things: 1) that he play the pairs quickly, rather than giving each the full 300 milliseconds he had planned; and 2) that he add a slight bit of noise fused to the sounds to make them a bit more congenial to the musicians. African music, as you probably know, often has a noisy component in it, and I thought as long he was testing indigenous perception he might as well make the music as "indigenous" as possible. He was reluctant for reasons having to do with experimental design, but finally he agreed that there was some logic to making these changes. The whole thing was very portable—he had good earphones and software on a laptop that ran the whole test, so all subjects had to do was to click on whichever of the five pairs contained dissimilar sounds.

Now, you have to realize that I was not working with Afro-Pop musicians—these were real old-school traditional musicians, in some cases fairly elderly, who lived in the hills of Burundi and whose only contact with technology was to try out the earphones on my cassette recorder. Getting them used to a mouse was the biggest challenge of the entire test. At any rate, I was curious to see how they would do, since the music they specialized in was a genre defined primarily by timbre, and I wondered if this would make a difference. Of the 43 musicians who participated, 14 (if I remember correctly) were probably 45 years old or more, and of those 14, nine produced results that were astounding. At first, they seemed to make no sense whatsoever, because their answers were nearly random, with no intelligible connection between the token they recorded on the computer and the actual target. So Jonathan spent hours running all kinds of statistical tests on the results, he tried to find regularities that correlated the nine musicians' answers with the tokens' pitch height or spectral shape, and probably other things I do not know about. Finally, he conducted long interviews with the nine musicians, and me translating. They seemed to have understood the instructions, they had mastered the technique of clicking on the screen to indicate their answer, they did not especially like the sounds, but they at least went through the whole test, and their hearing was normal enough to satisfy the standard criteria for lack of impairment. It was all a

mystery. Jonathan had the responses in number form on a separate page for each musician. One day, I sat down and translated the answers of the nine musicians from number into spaces according to the order they occurred. **[Example 1]** is the first page of a response sheet from one of them. It will give you an idea of what I found for all nine. It does indeed look a bit random at first glance, but after looking at it for a while, I saw that it was not at all.

As **[Example 2]** shows, this musician, like the other eight "mystery subjects," had created a pattern of answers that satisfied some aesthetic of his own—another of the response sheets was much more intricate than this one, and I wish I could show it to you, but Jonathan took it back to Stanford. When I first showed him the transcriptions, he shook his head, thinking that the musicians had been playing with him, and it took me a while to convince him that some of the patterns were too complicated to be simply memorized and reproduced with clicks on the computer screen as each set of pairs went by. In other words, I needed a visual representation to realize patterns that somehow these four musicians had reproduced while listening to pairs of tones. Together Jonathan and I re-interviewed the four musicians, and they were completely consistent in their response that they had really heard the pairs as they marked them. In fact, two of them claimed to be surprised when they saw the patterns their answers had created. Finally, even so skeptical and politically incorrect a scientist as Jonathan was persuaded that the musicians had truly and legitimately registered their phenomenal experience. They had indeed perceived the sounds as indicated on their answer sheets. Whether or not the added noise and shortened tones contributed to the musicians' perceptions of the tones or whether it was just a function of the kinds of timbres Jonathan had constructed, I do not know. He went home believing that my changes to his sounds had somehow provoked the curious results of the four elderly musicians. But for me, it was the moment that I realized how individual, how flexible, how idiosyncratic timbre perception could be. The personalized form of timbre perception betrayed by the nine musicians who Jonathan thought had ruined his experiment resonates loudly with the point of the first story I told—that the influence of conceptual abstractions on the regularities of perception can be profound and startling.
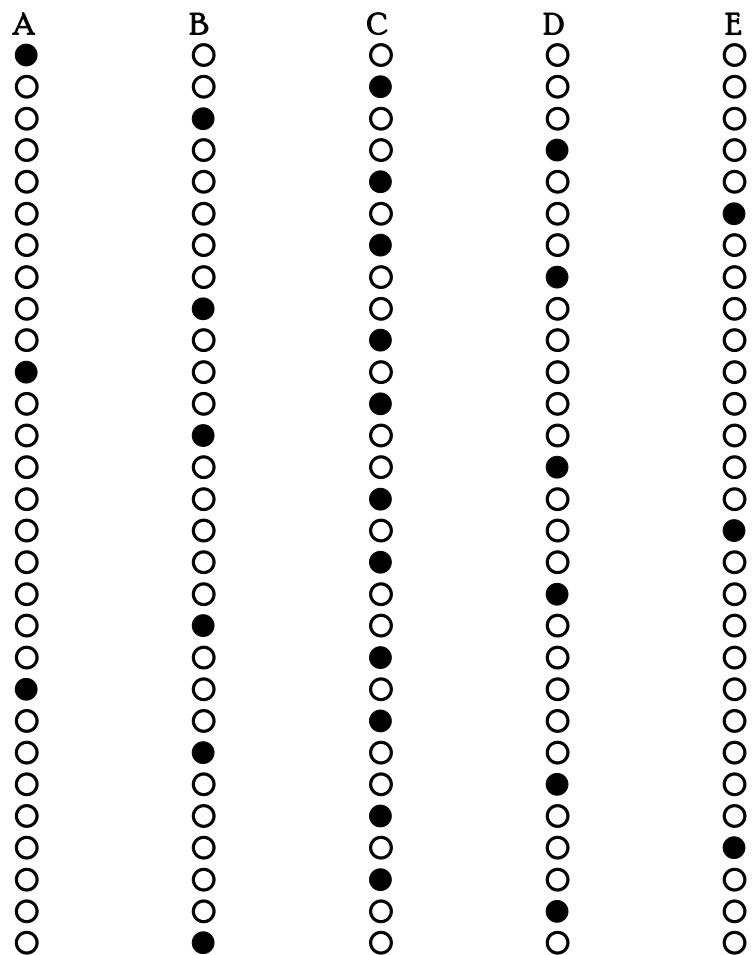
Example 1. Response Sheet from Barundi Musician.
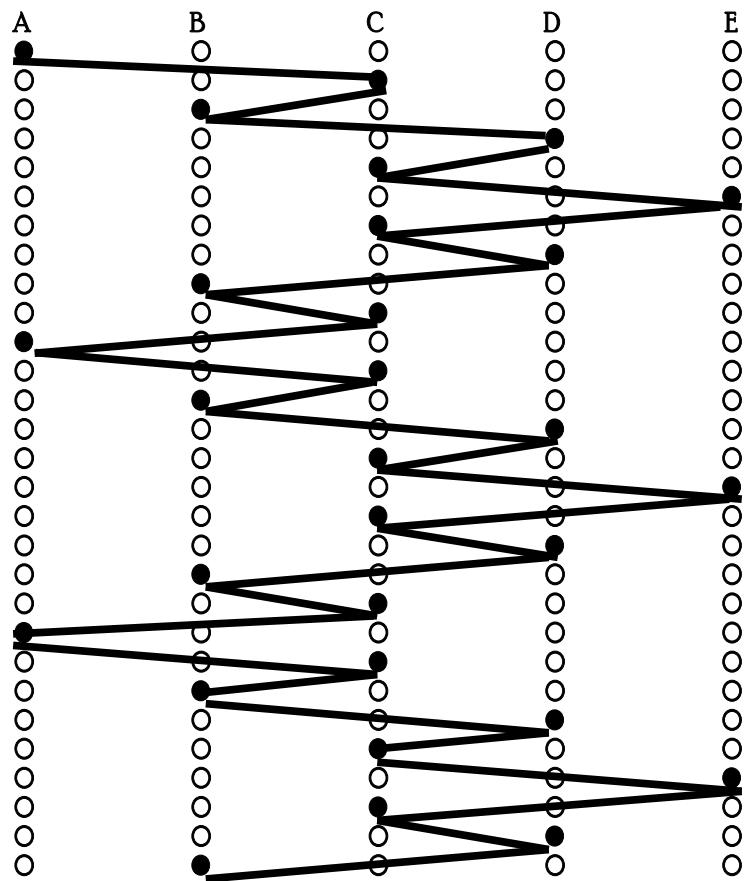
Example 2. Pattern of Answers.

It is very tempting for ethnomusicologists in Africa to ground analyses in the exigencies of the environment. Early fieldworkers often tried to explain stylistic regularities as the result of features inevitable to homemade, nonstandard, roughly-tooled instruments constructed from natural materials. For example, even now one hears that the practice of pitch-hocketing by some groups in southern Africa is the result of the construction of instruments of limited pitch range—and this, in spite of the fact that the same groups may pitch-hocket in vocal forms of music as well. But while the ecological approach may at times amount to a legitimate form of conjecture, it is also true that over the centuries, Africans have evolved ingenious solutions to the musical problems inherent to their environment, and it is risky to assign an origin to what has clearly become a matter of aesthetic.

What seems less risky is to hypothesize that the environmental factors encountered by musicians looking for new sounds and structures, gave the trial-and-error process at the heart of all invention a wider latitude of potential solutions than the same process in cultures where religious, theoretical, or social constraints regulate the shape of trials before an error has a chance to be made. The aesthetic preference that ultimately stops the trials develops from a far broader base in an African culture than it might in a culture where, for example, noise is considered at such odds with music that listeners never have a chance to evaluate its musical potential to begin with. Or in a culture where the notion of rationality is simultaneously so elevated above physicality and so tied to vocal expression that purely instrumental music is considered suspect and potentially corrupting.

I would offer another possible solution, which Africans found, to the limitations imposed by environment that the Western tradition has used with some frequency through its history, but often almost accidentally, or at least without the awareness with which it is applied in Africa. Some of the many kinds of trite characterizations of African music often heard in undergraduate world music classes are that African music is participatory, there is no such thing as someone who is nonmusical, the performer/audience divide is nonexistent in Africa, and everyone does something during a performance—if nothing else, they dance or create extra percussion by clapping. I am afraid that those characterizations are really more hackneyed than true—there are many forms of music for which an audience is nothing more than an audience, doing nothing but absorbing the music. There is very definitely a sense on the part of musicians, however, that the audience participates as listener in a very active way. In Burundi,

141

that is, musicians rely on what I think of as the auditory imagination of listeners to supplant the acoustic limitations of an instrument or voice.

Elsewhere I have described a kind of taxonomy of timbre effects that work essentially by offering various schemes of perceptual organization via the "artifactualization" of music—in effect, a transformation of musical sound into easily reversed artifacts, like the visual figure-ground images discussed earlier in which there is no predetermined "correct" percept. One category of artifactualization is largely acoustic, but another is purely perceptual. A musician sets up a situation in which he or she indicates the desired percept on the part of listeners and, if successful, persuades them to perceive accordingly. It is as though the musician offers an alternative perceptual schema, and draws listeners into a world where that schema takes precedence over the default schema of auditory perception in a nonmusical context. To some degree, this substitution of perceptual schema is built into a genre's history, as listeners learn through generations of hearing the music to accept the alternate schema. But this acceptance is not automatic (after all, the musician is asking his/her audience to forgo a form of listening intended to be a tool of survival) and Burundi musicians acknowledge that there are "good" and "bad" listeners.

There is even a phrase in Kirundi to describe the willing participation of listeners, and that is *mu maraso*, which means essentially "in the blood." It is applied to both musicians and listeners: for a genre of music played on the trough zither, *inanga*, both a talented musician and a good listener are possessed of *inanga mu maraso*. A listener specially gifted with *inanga mu maraso* is one with a particularly flexible auditory imagination, able to detect the musical intentions of a performer—whether successful or not— and willing to submit to those intentions perceptually whether they are actually present acoustically or not. Similarly listeners often say of a really bad performance—not that it was unpleasant or incorrect, but that it was just too difficult—that whatever indications the performance offered as to the musician's intent was either difficult to decode or impossible to realize perceptually from the sounds available.

"Whispered *inanga*" is a traditional genre of Burundi music.[62] As I just noted, *inanga* is the name of a plucked zither over which you will hear that the musician whispers a text. Like over half the languages of Africa, Kirundi is tonal.[63]   One of the things that ethnomusicologists have

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[62] For an example, hear *Inanga Chuchotée* on CD accompanying Fales 1998.

[63] A tonal language is one in which pitch height is grammatically or lexically significant. That is, a high tone on a syllable of a word may distinguish it from

discovered in the course of the field's history is that in almost all cultures of the world where people speak tonal languages, some part of the musical repertoire contains vocal music whose melodic content follows the linguistic tonal contour of the text. In Africa, this happens often—in fact, it happens frequently even when the music has no text, using the method most common in the proverbial "talking drums" of west Africa. Talking drums communicate with patterns of pitches that mimic the tonal shape of a limited corpus of formulaic phrases or proverbs, so that an indigenous listener decodes them intuitively. In this case, the melodic material goes from accompanying a vocal text, complete with tonal changes, to actually substituting for a vocal text whose speech is somewhat impoverished. I cannot say with any assurance that such sounds are comprehended effortlessly just as they would be if fully articulated, but in my experience, most African listeners are able to translate instantaneously one or two words when asked. There is a sense in which all Burundi, and much African music generally, has a semantic referent whether explicitly or implicitly. There is also a sense in which the assumption of lexical meaning in music, whether a listener bothers to discover it or not, at least invokes an expectation of implicitness. In a very profound way, indigenous listeners to traditional African music understand that not all elements of the music will be provided by the musician; a great many of the music's effects—often the most important effects—will be the responsibility of the listener.

So the entire experience of whispered *inanga* is built on a low-level auditory illusion that operates on the basis of the audience's ability to turn the acoustic implicit into a perceived explicit. It works like this: a whisper is acoustically absent of pitch, since it is produced with relatively flaccid vocal chords that serve mostly to set up turbulence in the place of discrete harmonics. A whisper is more or less narrow-band shaped noise, lacking a fundamental and its harmonics, without discernible pitch. When done correctly—without any voicing whatsoever—the whispering musician is incapable of making pitch distinctions; he can trace neither the melody nor the tonal contour of the text with his voice. Instead, he plays the melody he cannot produce on the *inanga*, and thus projects the tonal contour of the text onto the instrument. In this way, the instrument and the musician share responsibility for the vocal part of the music—the *inanga* does what the performer's voice cannot do.

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another word which is otherwise identical; similarly, tone may distinguish parts of speech or tense.

What is striking about the way listeners describe *inanga* is that they are all emphatic about the fact that the musician is singing to the melody of the *inanga*. They point out that if the musician **were not** singing, he would be "mis-speaking" the words—his voice must meet the strings and the words, or he would be mispronouncing words or speaking ungrammatically. Without going into all the details, I will say that to the average Burundi listener, whispered *inanga* hinges on the perception of pitch variation in a noise medium that normally cannot sustain frequency movement. Specifically, what happens is that some part of the frequency content from the *inanga* becomes attached to the vocal whisper, lending it a pitch sense that its source—that is, the singer—is not producing itself. There are a series of generic rules for how to sing whispered *inanga* that I will not go into, but the result of following those rules is that the audience ends up looking for vocal elements in the *inanga* and instrumental elements in the voice, until the two sources begin to interact perceptually. Of course, the actual displacement of elements is nothing the musician is doing, except in his choice of appropriate sound sources to stoke the auditory imagination of his audience. But ultimately, it is the "good listener" who stretches the capacities of ordinary processing mechanics in order to lift discrete harmonics from one source and fuse them to the other. In the case of whispered *inanga*, our non-indigenous ears prevent us from being good listeners, no matter how hard we try, but Burundi musicians' choice of whisper as an acoustic medium is able to encourage this kind of listening. They use what I call the "sponge effect" of noise—that is, its inclination to adopt features of simultaneous, more structured sounds that approach or overlap with some part of the bandwidth of the noise.

Whispered *inanga* is not a particularly exotic genre of music, and the requirements of listeners are not unusual for African music at all. In my experience with sometimes extremely unworldly musicians, a notable characteristic common to those who were any good at all was that they were acutely aware, sometimes only intuitively, but sometimes deliberately and articulately, of the degree to which they could push the audience, and the limits of the ordinary, though well-exercised auditory imagination working in service to music. With careful observation, a researcher can document the devices used by musicians to provoke the proper kind of perception for their music, as well as the characteristics of "good listeners" while in the process of supplying what the music lacks. For example, *inanga* musicians never perform in the daytime—and usually at night there is only candlelight since there is no electricity. In addition, they typically sing with their heads close to the *inanga*—to minimize location cues for separate sources. But these

and other "tricks" are undoubtedly feeble if a listener is truly resistant. After long experience hearing whispered *inanga* in its normal context, I can tell which listeners are unable to grasp the illusion. They are usually the only ones who look directly at the musician, whereas a listener entrenched in the illusory effect of the music almost never watches the performer head on—probably because that would make the reversal more difficult. Ultimately, a performer can beckon to the audience with whatever devices he has at hand among the generic features of his music, but finally it is up to the audience as to whether they respond or not.

I am trying to make three points here. First, that whether or not it is because of ecological constraints on the sounds used in African traditional music, musicians work to provoke the highly nimble auditory imaginations of listeners; that is, they count on listeners' capacity for flexible listening—the ability to augment, rearrange, or cancel altogether the objective features of acoustic reality. Second, the large majority of the effects that work to elicit flexible perception in listeners are timbral and often noisy in nature; perhaps this is because timbre is a perceptual modification of objective reality to begin with, and thus more easily altered than parameters that closely correspond to acoustics. And third, though as a good Westerner, I have managed to abstract and systematize a number of processes that seem to characterize the meeting point of Burundi musicians and listeners and their music—happily, the same processes never reach so blatant, so rude a stage of consciousness among those who practice them. Perceptual processes remain invisible and reflexive to perceivers, and the shift between default and flexible modes of perception is always a silent act of implicit response. But the signs of implicitness are built into a long history of generic requirements, performance practice, and accepted audience behavior that governs music like whispered *inanga*. The results of this kind of implicit perception can be recognized in concepts like *inanga mu maraso*, in the mythic, religious, or historical trappings associated with a genre of music, and in the often observed fact that many forms of ritual music make use of timbres, particularly noise, that work to enforce a privileging of auditory over visual information.

A robust statement of these three points is the assertion that in cultures like that of the Barundi, the very implicitness—the lack of conscious abstraction and analysis—of individual parameters of sound, is a primary factor promoting the more active use of, and emphasis on, timbral elements in African music. In music unsullied by the isolation of parameters that analysis fosters, it is difficult to translate indigenous perception into terms familiar to Western scholars: is timbre a function of pitch, or is pitch a

function of timbre? Or is there a perceived quality familiar to Burundi listeners that is neither pitch nor timbre, but both equally? Or—and this is my favorite possibility—maybe a "good listener" hears and evaluates musical sound somewhat analogously to speech sounds as received by ordinary native speakers. With neither tools nor inclination to analyze each sound as it passes, a listener normalizes differences in pronunciation within a certain range of variation, and otherwise fits them reflexively into categories like "regional accent," "foreign accent," "sounds like Aunt Nancy," or "unintelligible"—all without any awareness of the process at all.

Whatever its ecological origins, for the Barundi at least, flexible perception is most immediately an aesthetic preference—one that entails variations of timbre produced equally on the instruments of musicians and in the perceiving minds of listeners. In a culture where the creation of musical sound is an effort deliberately shared by musician and listener, perhaps the ideal notion of "tradition" is the historical body of conventions by which everyone knows what each must do to bring an appropriate sound into being. With the confidence of tradition behind them, participants in such a culture are secure in their dependence on the participation of others and gracious in their assumption of the role they are assigned. Like the acquisition and use of a native language, the conventions are transmitted and strengthened with each occasion of use, so that barring some unanticipated influence or disruptive event, the tradition is theoretically self-sustaining and infinitely long-lived.

I admit that this description is excessively idyllic, approaching Rousseauian-level clichés. But I am talking about Western music abstractions here, so there is a core of truth informing the description. Whatever the real-life glitches omitted from my account, the fact is that if tradition functions primarily as a repository of conventions regarding fairly complex cognitive behavior (and idyllic or not, this is not an unrealistic representation of segments of Burundi society), then it must be self-sustaining or die. No amount of descriptive or prescriptive analysis in ordinary language can reproduce the behavior as enacted by and transmitted through generations. The nature of the conventions requires that the prescribed roles remain reflexive, automatic—in the terms established here, implicit. The interaction of roles captured in the conventions of tradition must be unconsciously imbibed by participants, and reflexively carried out as a matter of social protocol.

What may have seemed at first an unlikely comparison—between the somewhat arcane requirements of Burundi whispered *inanga* and the cerebral doctrines of 18th-century musical aesthetics—were chosen for a

146

reason. In light of the special perceptual qualities of musical timbre, the cognitive habits that encourage its strategic use in music are best demonstrated in a culture that remains non-abstract, musically non-literate, and happily free of the urge toward conscious theorizing of processes that work most efficiently on a pre-attentive level. Compared to the Burundi tradition, the development of Western music theory ultimately produced a compositional model whose standards could only be met through rigorous conformity to its rules. From the point of view of timbre awareness, what Rameau began with the purest of unreasoned instincts, finally became an instrument of rigor and self-scrutiny, pricking a composer's intellect back onto the level of conscious awareness with each lapse into the depths of creative intuition. If it is true that that we are hardwired to absorb and react to auditory—especially timbral—information subliminally or with only semi-awareness, then one might say that the enthusiasm of Rameau and his successors for naming the unnamable and documenting the implicit, elevated the already salient parameters of pitch and loudness to new prominence, putting timbre at a disadvantage that is only now being recovered.

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THE ARCHITECTURE OF TURKISH VOCAL MUSIC:
MÜNİR NURETTİN SELÇUK

Nilgün Doğrusöz

INTRODUCTION

Münir Nurettin Selçuk (1900-1981) is considered one of the most revolutionary vocal recitalists of Turkey. This paper examines the aesthetic appeal of Selçuk's singing through spectrographic analyses of *a capella* performances. By tracing Selçuk's exploration of the sonic possibilities of register, articulation, vibrato, and glissando, we can examine the nature of change in Turkish musical aesthetics. The spectrographic analyses are based on a song (*şarkı*) and a vocal improvisation (*gazel*), both in Hüzzam *makam*. The varieties of spectral variation, dynamic nuance, and the regulation of the heightened resonance of the vowel formants are discussed. A combination of musical with textual-linguistic analysis reveals the unique quality of Selçuk's articulation of consonants and vowels. The changes in his singing that occurred after his attendance at voice classes in Paris placed his work in the vanguard of Turkish singing. The spectral analysis of those changes offers a new perspective on one of the leading architects of Turkish musical aesthetics.

THE MUSICAL LIFE OF MÜNİR NURETTİN SELÇUK

Münir Nurettin's interest in music appeared when he was a child. His brilliant voice enabled him to attend the Numune Mektebi middle school in Kadıköy, Istanbul. During these years he was invited to study at the Darülfeyz Music Society. In that period there were many societies that, like the Darülfeyz, resembled small music conservatories. At the same time, Münir Nurettin took private lessons through the *meşk* oral teaching tradition that featured such masters as Zekaizade Ahmet Irsoy and Üsküdarlı Hoca Ziya Bey. He therefore learned how to sing Turkish music the traditional way. His talent was recognized, and he gave his first solo recital at age 14 in a concert given by the Darülfeyz Music Society at the Apollon Theatre.

In 1907 he passed the exams of the Darülelhan (literally, "Melody House") music school. This allowed him to start performing regularly at the

Darülelhan with such masters as Ahmet Hafız Efendi, Leon Hanciyan, and Muallim İsmail Hakkı Bey.

In 1917 his father sent him to Hungary for training in agriculture, but later allowed him to come back to Istanbul. After his return he attended the Şark Musiki Cemiyeti (East Music Society), directed by Ali Rıfat Çağatay. There he learned the *fasıl*[64] tradition from Bestenigar Ziya Bey and was also influenced by Çagatay himself, who is believed by some to have made an important contribution to Selçuk's new perspective (Orhon 2003).

Whilst a soldier he joined the Mızıka-i Humayun in 1923, finding there an opportunity to perform with the famous *tanbur* player Refik Fersan. He also performed for three years with the Riyaseti Cumhur Heyeti (Presidental Orchestra) for Mustafa Kemal Atatürk. He studied European music theory, solfege, and piano and, with the support of record company Sahibinin Sesi (His Master's Voice), was able to study voice in Paris for two years from 1927.

In traditional singing style, trills and glissandos are frequently used. The so-called *goy goy* style makes rich use of glottal vibrato. In particular, the singers of improvisations (*gazel*-s), who preferred *goy goy* style, were mostly *hafız*-es (Kur'an reciters). Münir Nurettin Selçuk was, however, an exception. He used a nasal voice and divided the words by taking breaths at appropriate places in the music. He employed the *goy goy* style in a less exaggerated manner than the *hafiz*-es. (For an example, listen to the Ferahnâk Yürük Semai composed by Şakir Ağa, *Bir dilbere dil düştü ki mahbûb-ı dilimdir*, track 5 on the compact disc *Münir Nurettin Selçuk*.)

The voice classes in Paris helped him to shape his performing abilities. He learned how to control his breath and to skip smoothly from one pitch to another, and he correctly recognized the distinction between head voice and chest voice. It is clear that his singing style became purer and simpler than that of earlier singers. His use of intervals was unique. He gave importance to nuances and diction. However, he did not abandon entirely the older singing style. Rather, he achieved a synthesis of the two approaches. Inevitably, his individual approach influenced his successors. He brought new perspectives to the Turkish singing style and became one of the most important cornerstones of Turkish vocal music.

After returning to Istanbul in 1930, Selçuk gave a concert on the stage of the French Theater in Beyoğlu. In this concert he was accompanied by Nubar Tekyay (violin), Ruşen Kam (*kemençe*), Mesut Cemil (*tanbur*), and Artaki Candan (*kanun*). Afterwards he gave several more concerts. Starting

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[64] *Fasıl* is a traditional suite form in Turkish classical music.

in the 1920s, he made a number of records for such companies as His Master's Voice, Odeon, and Orfeon. Included on these recordings are a number of *gazel*-s.

SPECTROGRAPHIC ANALYSIS

The first spectrographic analysis is of Münir Nurettin Selçuk's recorded performance of a song (*şarkı*) titled *Çıkar Yücelerden*, in Hüzzam *makam*. Available color spectrographs have been made with Spectro Pro Software. [65] These analyses focus on linguistic features, text setting, musical structure, and sound. For this study a compact disc entitled *Istanbul 1925* (track 2) was used. These pieces first appeared on 78-rpm records, and were later transferred to digital format. **[Examples 1 and 2**, **CD 1:2**.]

Text:

Çıkar yücelerden haber sorarım,	By going out I ask for news from high ones,
Solarken dağların gümüş yıldızı.	As the silver star of the mountains is fading away.
Bilmem neredeyim, neyi ararım.	I don't know where I am, what I am looking for,
Uyanır içimde derin bir sızı.	A pain deep inside me wakes up.
Derim neden yoksul gezdiğim bağlar,	I say why the gardens that I visit are poor,
Yok mu bu ellerede benimle ağlar?	Isn't there anybody in this country who will cry with me?
Sesime ses verir dumanlı dağlar,	Smoky mountains give voice to my voice,
Derdime eş olur bir çoban kızı.	A shepherd's girl becomes part of my sorrow.
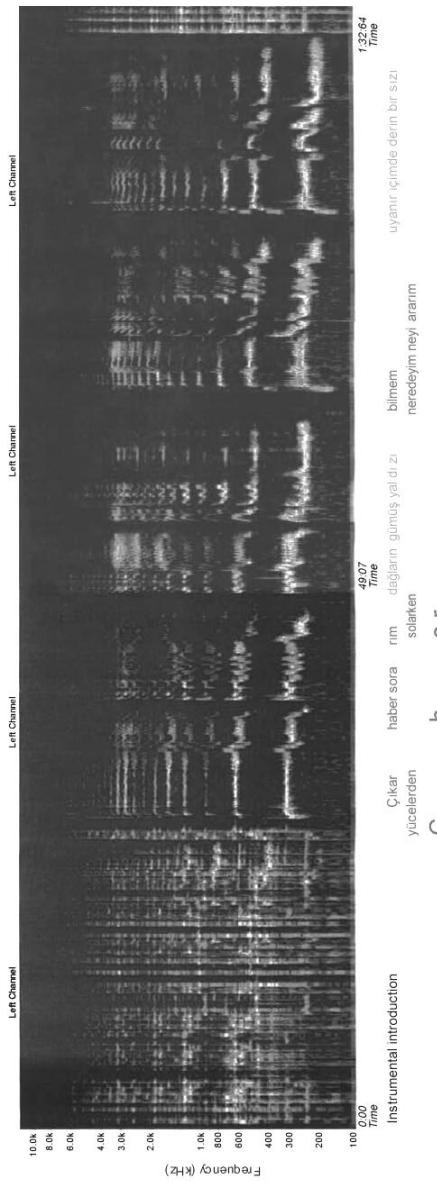
Example 1. *Çıkar Yücelerden* (performed by Münir Nurettin Selcuk): Spectrograph. Duration: 3 minutes, 7 seconds.

Example 2. *Çıkar Yücelerden* **(Composer: Saadettin Kaynak; Text: Vecdi Bingöl).**

153

The song is sung by a solo voice, although some instruments (*kanun*, *darbuka*, and *keman*) are heard in the *aranağme* (non-vocal prelude). The singer is accompanied only by one instrument, the *tanbur*, when the singer is on the horizontal tonic (*karar*), in order to indicate to the singer the correct pitch. This makes the song ideal material for an analysis of vocal sound and performance. Indeed, the song is a marvellous example of a poet who creates verbal music, which then becomes the basis of the composer's vocal music.

The spectrograph begins by rising from registers three to four and later descends through all of register three **[Example 3]**.

bilmem nerede yim   sesime ses verir
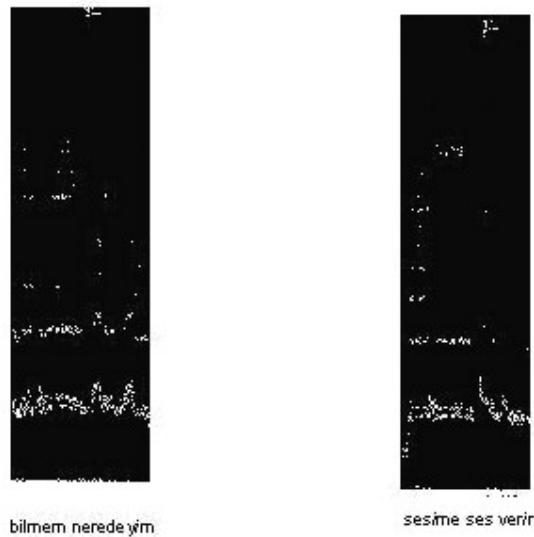
Example 3. *Çıkar Yücelerden*: Beginning.

The spectral tracings of the melody in **[Example 1]** are other tracings—upper partials, or overtones—which vary in quantity and density, and which are produced by the combination of words, melody, and the man's voice. We can see how the spectral configuration changes at different moments of the piece, depending on the particular vowel being sung.

The total spectral range of a specific musical work is divided into three equal parts: grave, neutral, and acute. The designation "grave" indicates activation of some part of the grave space. The designation "acute" indicates

154

activation of some part of the acute space. The designation "grave-acute" indicates activation of both the grave and acute spaces simultaneously. In the spectrograph this spectral range is shown by colors. Bright colors, such as red and yellow, refer to acute parts; green and blue to neutral; and dark colors, like blue and black, refer to grave **[Example 1]**. We made spectrographic linguistic work related to eight Turkish vowels produced by one female and one male speaker **[Example 4]**. According to this spectrum, the Turkish vowels can be ordered as follows:

Neutral	**Acute**	**Grave**
a, ı, ü, ö	*e, i*	*u, o*

Now we will examine the shaping and sonic consequences of this spectral variety briefly. One of the first revelations of **[Example 1]** is that a single vowel [*e*] and its characteristic spectrum dominate the entire song. The first prolonged word, "*yücelerden*," immediately reiterates the [*e*] spectrum, whose widely spread elements activate all the registers between the extremes of three and seven.

Prominent vowels in the first verse include:

    In line 1: [*e*] *yücelerden*, [*a*] *sorarım*
    In line 2: [*ı*] *yıldızı*
    In line 3: [*e*], [*i*] *neredeyim*, [*a*] *ararım*
    In line 4: [*e*] *içimde*, [*ı*] *sızı*

Prominent vowels in the second verse include:

    In line 1: [*u*] *yoksul*, [*a*] *bağlar*
    In line 2: [*e*] *ellerde,* [*a*] *ağlar*
    In line 3: [*e*], [*i*] *verir*, [*a*] *dağlar*
    In line 4: [*u*] *olur*, [*ı*] *kızı*

The [*e*] spectrum is also prolonged in line 4 in the word "*içimde*." The vowels of the rising line in the first half of the design are almost bright, comprising many [*i*]s and [*e*]s: "*bilmem neredeyim*" and "*sesime ses verir*" **[Example 6]**.

155
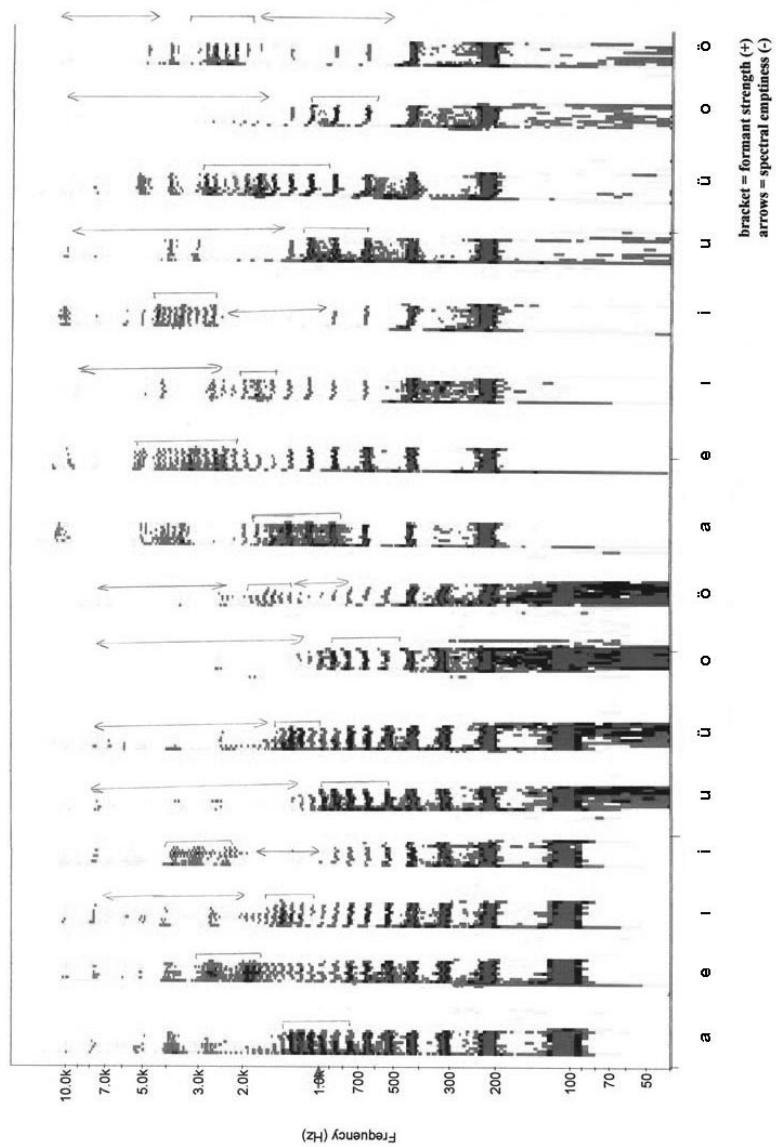
Example 4. Eight Turkish Vowels (Male and Female): Spectrograph.

156

Example 5. *Çıkar Yücelerden*: **Linear Analysis.**

bilmem nerede yim   sesime ses verir

Example 6. Formants of Vowels [*e*] and [*i*].

Vowel [ɪ] is neutral—actually close to bright—but in the spectrograph its formant is weak or dark. It usually comes at the end of the melodic line, as in *sızı*, *ararım*, and *yaldızı* **[Example 7]**. To express the sad feelings of the text, Selçuk sings here very softly, and this gives a different character to vowel [ɪ].

yaldızı   ararım   sızı
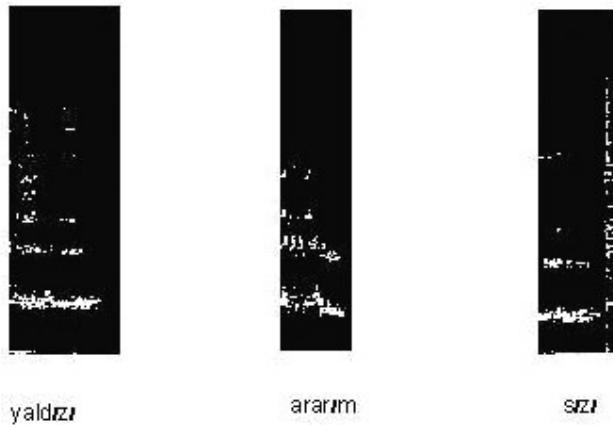
Example 7. Vowel [ı].

We turn now to Selçuk's consonants. It can be observed that when consonants, as opposed to vowels, are obscured, language becomes incomprehensible. The consonants are an important feature of Selçuk's performance, and in the spectrographs are shown as vertical elements that briefly interrupt the horizontals of vowels **[Example 8]**. Selçuk's voice has both a rich singer's formant and an almost entirely rich vibrato—one that is wider, generally, than that of European singers. He prolongs the pitch first, then starts to produce vibrato **[Example 1]**.

çıkar   haber
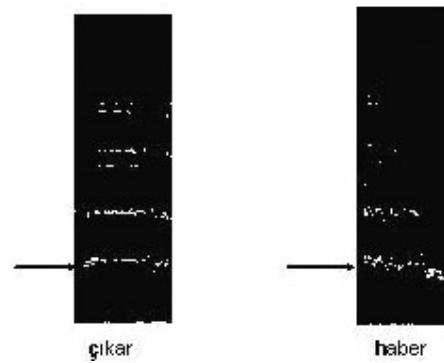
Example 8. Consonants [ç] and [h].

159

The second sample, also in Hüzzam *makam*, is based on a *gazel* and is titled *Kıldı zülfün tek perişan*. Selçuk is accompanied here on the *tanbur* by Mesut Cemil. Track 15 of a compact disc named *Tereddüt* was used for the analysis. Its subject is the common theme of love. In *gazel* form, the performer chooses a *murabba* quatrain, as Selçuk did. The selected quatrain is given below **[CD 1:3]**.

Kıldı zülfün tek perişan halimi halin senin.	Your locks [of hair] and demeanor made me really miserable.
Bir gün ey biderd sormazsın nedir halin senin.	You without worry, you never asked, "how are you?"
Gitti başımdan gönül servkaddin sayesi.	The shadow of the tall lover left me alone.
Ağla kim idbâre tebdil ikbalin senin.	Don't cry, because your misfortune turned to luck.

The lyric poem in four-line stanzas was based on a classical poetic meter from Divan literature (the period of classical Ottoman poetry). Selçuk freely elaborates on the Hüzzam *makam* in ways he considers suitable to reflect the meaning of the quatrain. The *gazel* starts with the *tanbur*, and the voice then enters alone. There are three short connecting melodies on *tanbur*, which support the singer by following the melodic progression. This is certainly a well-improvised *gazel*; the performer has created a remarkable melody for each line of the poem. We need to mention the typical things that happen in the quatrain. He sings strikingly close to the *makam* in the first two lines (parts a, b1, and b2**;** see **Example 9**). However, when the singer reaches the third line, or *meyan* (middle part, c), he is hiding the upper tonic, which gives him a chance to show off his vocal range. Selçuk does not modulate to another *makam*, but he shows his remarkable range, reaching pitch B♭4. His repeat of the fourth line is similar to the first two lines in that it finally returns to the initial *makam*. He finishes the *gazel* on the higher tonic.
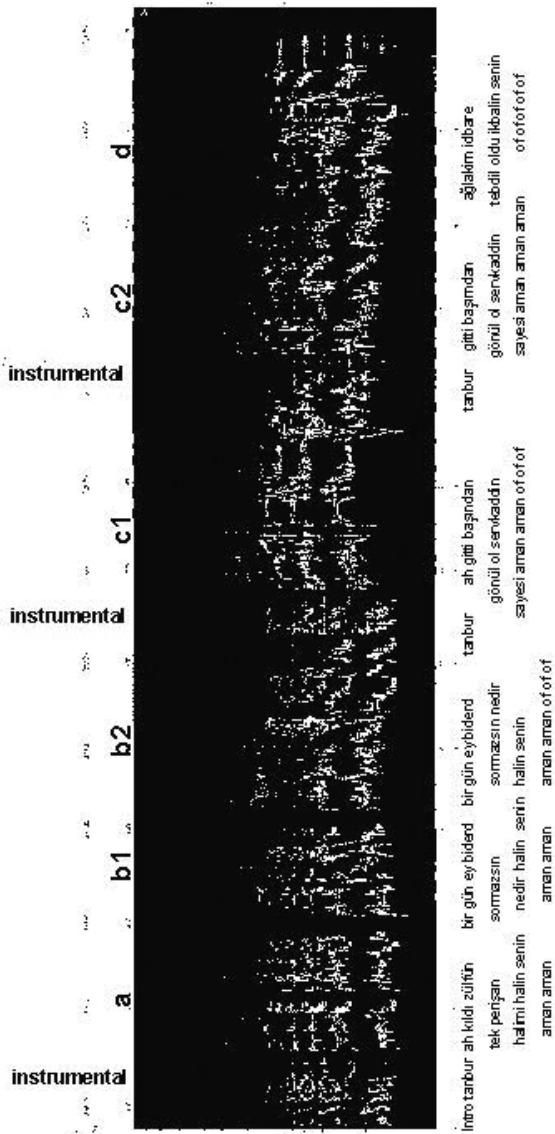
Example 9. *Kıldı zülfün*: **Spectrograph.**

161

Let us have a look at the spectrograph for the entire piece, and then at some specific features of Selçuk's singing style **[Example 9]**. The spectrograph begins by rising from register three, and later it descends through all of register four. The heightened resonance of the singer's formant reaches register seven in the third stanza (where the highest pitch, B♭4, is reached), and it adds to the acute quality of his voice (in the spectrograph this is represented by red **[Example 10]**).

The heighten formant of singer

... ah gitti başımdan gönül ol servkaddin sayesi aman aman of of of tar
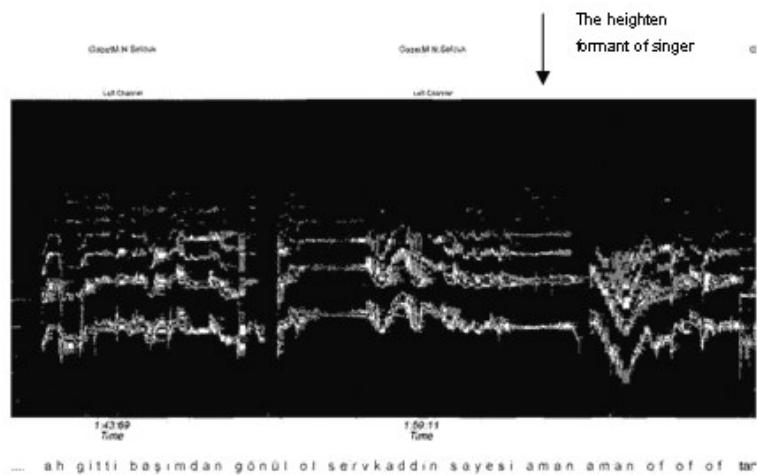
Example 10. Heightened Resonance of Singer.

It is obvious that the pronunciation of both vowels and consonants is clearly discernible in Selçuk's spectrograph. The sustained sounds are consistently bright. For example, the "of" syllable at the end of the spectrograph should be grave, and on the higher tonic instead of the regular one; however, it is still bright and acute because of the formants and color that arise from Selçuk's regular vibrato. His vibrato is mostly wide, although sometimes a narrow vibrato is used also. Another characteristic of Selçuk's technique is that the pitch is initially sustained before the onset of vibrato **[Example 11]**. Glissando is also applied **[Example 12]**. His selection of pitches is unique, and their use masterly **[Example 13]**.

Of

Example 11. A Sample of Vibrato.

Of

Example 12. A Sample of Glissando.

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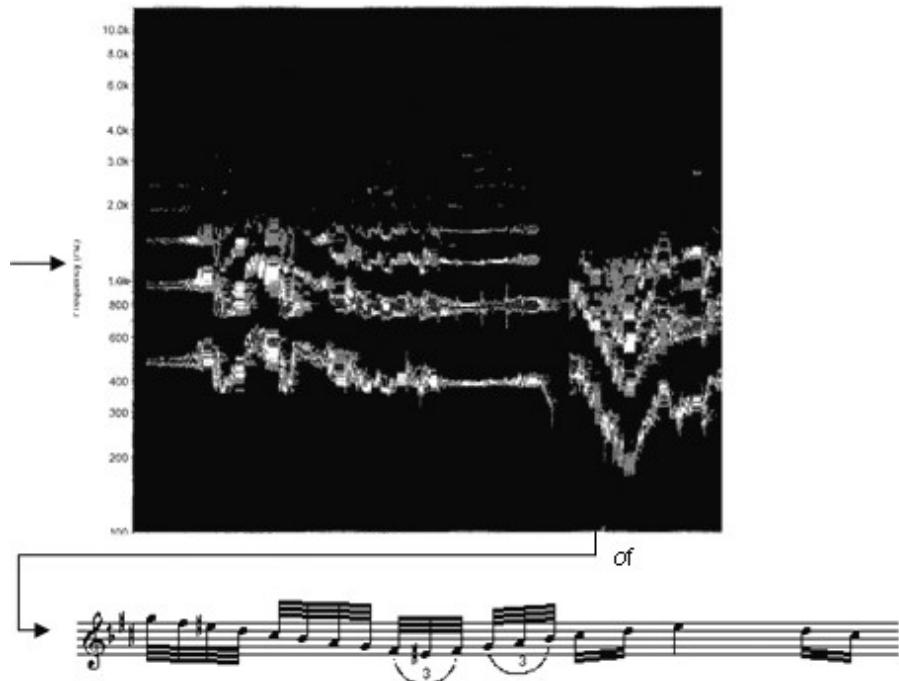
Example 13. Melodic Line.

CONCLUSION

We can see Selçuk's emphasis on linguistic or musical features, the varieties of vibrato, dynamic nuances, glissando, and the regulation of the heightened resonance of the singer's formant.

An important feature of Selçuk's performances, however, is his very clear articulation of the textual consonants, shown as vertical elements that briefly interrupt the horizontals of the vowels. Linguistic research has repeatedly shown that the comprehensibility of language depends primarily on the articulation of the consonants. However soft and spectral Selçuk's chosen tone color for a particular phrase may be, he takes particular pains to articulate its consonants. The spectrographs reveal enormous variation in Selçuk's pronunciation, vibrato, and use of consonants.

Münir Nurettin Selçuk influenced a whole generation of singers with his extraordinary manner of singing. He was one of the greatest vocal recitalists

of the 20th century, and among the most distinguished Turkish composers. The images of his singing offered by spectrographic analysis offer new paths to sonic and musical understanding of Turkish vocal music.

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DISCUSSION

Cornelia Fales: Would it be very difficult for you to put a linear view, I heard you say you had a linear view. Could we have a sample of a linear view?

Nilgün Doğrusöz: Sure. I'll put the music on so you can understand the idea. [Plays example.] And just the sound here, a sort of [*a*] sound, a vowel. Do you want to listen to another one?

CF: For me, that's enough.

ND: [Example repeated.]

CF: So is that a linear view or logarithmic view?

ND: Linear.

CF: If it is, what it means is that he's doing something really interesting. What it means is that he's dropping out different harmonics, right?

ND: Yes. Because Turkish music is not harmonic music. I pushed it to make it like that but it's not hard to make it. I just put some drum voice and, for example, tonic as bass.

CF: Is this a picture of part of **his** voice then?

ND: Yes.

CF: Because it almost looks logarithmic to me, but if it's linear, what it means is that he's skipping two harmonics between the first and the fourth, which is an amazing technique that's really interesting.

ND: Actually, I have one more example, if we have enough time, and it's marvellous and I can show you the heightened core note. I couldn't show it in the first piece. It is worth listening to it. [Plays example.] This was called the middle part of the *gazel* and see, here he reaches register seven.

CF: Do you know what frequency that is at the top?

ND: At the top?

CF: You might not, it might not even show. How high up is he going in frequency?

ND: Okay. According to current Turkish music it's B♭, but there is a little problem here because we call 440 hertz for A but we say B.

CF: In hertz, do you know how far up he's going?

ND: Here. But please think four pitches lower.

CF: Okay, thank you.

VOCAL TIMBRE IN ISLAMIC CALLS TO PRAYER ACROSS CULTURES

Eve McPherson

INTRODUCTION

The work I have completed for this presentation is the result of my participation in a team research project guided by Professor Cornelia Fales at the University of California, Santa Barbara. The goal of the project was to study the possibility of developing a taxonomy of the voice, and it was supported by a research grant from the University of California. Each researcher chose a case study in order to engage various methodologies for analyzing timbre. In this project, I chose to research the call to prayer as a cross-cultural sound phenomenon.

Between 622 and 624 A.D., the Prophet Muhammed established the call to prayer in order to create a practice that distinguished Islam from other local religions. As it was historically, today a *mu'adhdhin* recites the call to prayer, known in Arabic as the *adhān*,[66] five times daily. Prayer times differ based on the position of the sun and the geographic location of the community. They are precisely determined to the minute and may change daily. When Muslims hear the *adhān*, they are called to reflect on the Islamic faith and their duty to pray. As such, they not only demarcate daily sacred time, but I argue they also communally create a deterritorialized religious space. The catalyst to the creation of this space and time is the sound of the call to prayer.

Why deterritorialized? Simply put, because today the world's Islamic population is both numerous—some estimates being as high as 1.3 billion practicing Muslims worldwide—and geographically widespread. While these populations represent diverse ethnicities, languages, and cultural practices, they are bound together through religious practice and belief. As a religious practice, the call to prayer is available to Muslims not only through local mosques, but also through live broadcasts and commercial recordings.

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[66] Common alternate spellings and pronunciations of *adhān* include *azan* and, in Turkish, *ezan*.

The call to prayer unifies Islamic communities through these various mediums. Tong Soon LEE argues that "... the Islamic community may be identified along acoustic lines" (1999: 87). Here, Lee is exploring the call to prayer as a geographically local practice in Singapore. However, I extend the idea to the broader Islamic world and theorize that certain structural aspects of the call to prayer, and the aesthetics that guide it, are fundamental to the formation of a deterritorialized Islamic community.

The traditionally constant elements of the *adhān* that serve to connect geographically and culturally disparate communities are: 1) that the call to prayer is recited in Arabic regardless of the local community's native language;[67] and 2) that the text serves the purpose of reinforcing core religious beliefs. The text for the *adhān* consists of five lines (there is an extra line included at dawn) as follows:

Allāhu akbar, Allāhu akbar	God is great, God is great.
Ashhadu an lā ilāha illā llāh	I testify that there is no god but God.
Ashhadu anna Muhammadan rasūl Allah	I testify that Muhammed is the prophet of God.
Hayya 'alā 'l-salāt	Come to prayer.
Hayya 'alā 'l-falāh	Come to salvation.
al-Salāt khayrun min al-nawm	Prayer is better than sleep [included only in the predawn call].
Allāhu akbar, Allāhu akbar	God is great, God is great.
Lā ilahā illā llāh	There is no god but God.

(Marcus 2002: 153)

While this text and its message are standardized,[68] historically however, it has not been uncommon for differences to exist melodically, modally, and rhythmically.

Rhythmically, the call to prayer is recited as unmetered text. Concerning melodic line and modal practice, these elements are generally chosen by the individual *mu'adhdhin* and have tended to be reflections of his personal

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[67] There have been instances historically wherein the call to prayer has been recited in a local language. Perhaps the most well known of such examples is the relatively short-lived mandate enacted by the Turkish Republic during the first half of the twentieth century, which directed the call to prayer be recited in Turkish. Today in Turkey the call to prayer is exclusively recited in Arabic (personal observation Istanbul, Summer 2003 and Mauguin 1968: 406).

[68] Slight variations do exist between the texts of *adhān*-s as practiced in different Islamic sects, but this cited text is most common.

training and cultural background. Another dimension of the sound is its acoustic structure. Unlike rhythm and melody, however, my investigation of the literature shows that acoustic analyses of the call to prayer have not been undertaken. The question therefore becomes, if we go beyond rhythmic and modal analyses, can we discern common acoustic patterns that occur across cultures and, like the text, contribute to shared acoustic space?[69]

I ask this question for two reasons. First, I hypothesize that certain common acoustic patterns may arise because the call to prayer exists as a functional sound art.[70] It is meant to be heard, and despite the 20th-century implementation of amplification in the call to prayer, a particular sound may have developed based on certain acoustic needs, such as the need to be heard across a distance, which in turn may have influenced aesthetic preferences for its recitation. References in the literature indicate that there are in fact distinct timbral preferences that influence vocal production in the call to prayer (Nelson 1985, Stone 1989, and Monts 1998), but these preferences are ambiguously defined. Second, some scholars indicate that the Cairene call to prayer, which is generally in Rast *maqam*,[71] a modal entity, seems to have left Egyptian borders and become a common model for *mu'adhdhins* throughout much of the world, due to Egyptian prominence in terms of broadcasting and commercial recordings (Levin and Matykubov 1991, Neubauer 2001: 602). Of course, there remain many noteworthy exceptions to this Egyptian recitation style. But, if the call to prayer is increasingly unified by the Egyptian sound in many parts of the globe through the use of broadcasts and recordings, and if certain acoustic features exist based on the

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[69] While it may seem a stretch to assume the presence of shared acoustic features, there is precedent for this hypothesis. Johan Sundberg, a prominent voice scientist, has studied opera singers extensively and has determined that certain shared acoustic traits are manifest in these voices. These traits are present no matter what the ethnic or linguistic background of the singer and seem to serve specific functional purposes. In particular, the presence of the "singer's formant" (a concentration of harmonics between 2500 and 3000 Hz) in altos, tenors, and basses, and the ability of sopranos to concentrate the first formant area at the fundamental frequency are strategies that allow these singers to be heard over an orchestra without great strain on the part of the vocal apparatus (Sundberg 1999: 175, 182).

[70] Issues of communal identity as it relates to sound have been explored by Lois āl Fārūqī (1986). She addresses the problematic status of "music" in Islam and promotes the alternate use of the term "sound art" (*handasah al sawt*) when discussing sound in Islamic religious practice.

[71] The lower tetrachord of Rast *maqam* is C – D – E half-flat – F.

function of the call to prayer, can such features be discerned and to what extent are these features manifest across cultures?

For some time, cultural theorists have suggested that geographically based scholarship be re-conceptualized in order to address the reality of diasporic communities and the arbitrary nature of national borders (Feld and Basso 1996, Gupta and Ferguson 1992, Soja 1989, and Appadurai 1991). On this issue, Gupta and Ferguson write:

> Physical location and physical territory, for so long the **only** grid on which cultural difference could be mapped, need to be replaced by multiple grids that enable us to see that connection and contiguity— more generally the representation of territory—vary considerably by factors such as class, gender, race, and sexuality, and are differentially available to those in different locations in the field of power. (1992: 20)

Arjun Appadurai echoes these ideas when he states:

> The landscapes of group identity—the ethnoscapes—around the world are no longer familiar anthropological objects, insofar as groups are no longer tightly territorialized, spatially bounded, historically unselfconscious, or culturally homogenous. (1991: 191)

In this paper, I have two goals. The first goal is the exploration of globally occurring cultural associations. As such, I have chosen to study the call to prayer across cultures as a sound phenomenon that creates a sacred acoustic space rather than a geographic one. My second and equally important task is the investigation of methodologies by which vocal timbre can be assessed and presented. The call to prayer presents an ideal case study due to the fact that it has several important common features that ease the process of cross-cultural comparison. These features are: 1) the uniform recitation of the *adhān* in Arabic; 2) that men generally recite the call to prayer[72]; and 3) that the call to prayer is recited, almost without exception, without instrumental accompaniment.

THE METHOD

While this project is ongoing, I have to date compared 18 samples of the call to prayer from 11 regional areas. My audio samples come from a variety of sources. Most have been obtained through libraries and archives but a few come directly from scholars working in the field.[73] Appendix 1

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[72] Boys have also been known to recite the call to prayer.

[73] I am particularly grateful to Dr. Scott Marcus (University of California Santa Barbara), Dr. Anne Rasmussen (William and Mary College), and Dr. Virginia

lists these samples and their places of origin. The regions from which the recordings come are: Uzbekistan, Morocco, Turkey, Liberia, Tunisia, Egypt, Saudi Arabia, Jerusalem, Pakistan, Kuwait, and Indonesia. Through comparisons of spectra, spectrographs, and my own auditory perception, I have sought to discover particular harmonics and/or concentrations of harmonics that are central to the sound quality. Second, I have analyzed the treatment of vowels and voiced consonants during onset events. These tasks were undertaken to determine any possible timbral similarities between the *mu'adhdhin*-s. It is important to note that the work I have completed is not definitive. Ideally, I should work with cultural insiders and rely on their auditory perception as opposed to my own. Additionally, the recordings should all be made under similar circumstances using the same equipment; unfortunately, the scope of the project made this impossible. For these reasons, at this time I consider my work a case study of methodological procedures; I hope, however, to collect data in order to complete more definitive work in the future.

STEPS OF ANALYSIS: METHOD ONE

To begin, all samples were recorded directly into Syntrillium Software Corporation's Cool Edit Pro 2.0. Having recorded the samples into this program, I identified excerpts sung on the same vowels and similar or identical pitches. Checking my accuracy with frequency analysis and by ear, I isolated similar pitch/vowel samples. In each sample the vowel is [a] and the pitches occur on or near B3 (246.9 Hz), C4 (261.6 Hz), C♯4 (277.2 Hz) and D♯4 (293.7 Hz).[74] Samples that shared a similar pitch were placed side by side in order to visually ascertain similar concentrations of harmonics. **[Example 1]** shows an abbreviated version of the chained C♯ samples.

I approached my analysis by first identifying common areas of concentrated frequencies and intense areas of activity with regards to single overtones. Appendix 1 outlines the areas I identified. Then, through a systematic filtering process, I determined those regions that contributed to vocal quality differences, as I perceived them.

Danielsen (Harvard University), who were generous enough to share their unpublished field recordings with me for the purposes of this project.

[74] The only remaining editing that was needed, was to decrease the decibel level of sample 10 in that it tended to become distorted in Cool Edit Pro 2.0 any time it was saved due to its extremely intense volume.
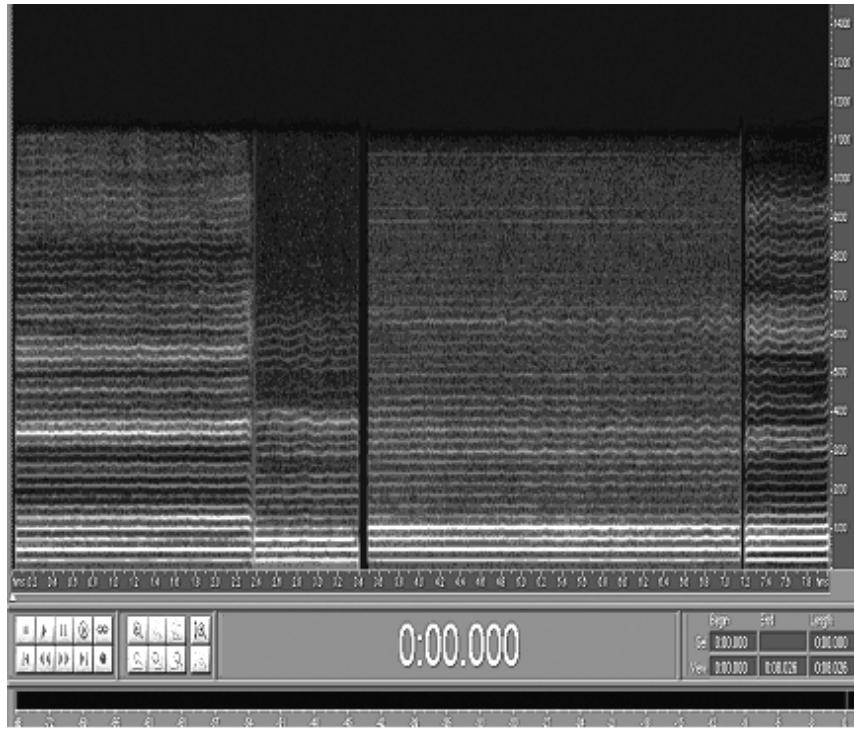
Example 1. Chained C♯ Samples.

The first step I took was to determine at what point the upper frequency regions could be cut off in the samples. My intent was to dispose of regions that made a negligible difference in terms of the sound quality. Appendix 2 lists the upper frequencies I was able to remove without affecting the sound quality.

Having identified these cut-off points, I then noted areas of similarity. The most prominent of these (as illustrated in **Example 1**) were:

1. In the 18 samples, a lower concentration of harmonics occurred between 200 and 2000 Hz, the first common formant area.[75]

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[75] By way of explanation, formants are patterns of emphasized harmonics that are determined by vocal resonances as produced by the shape of the vocal tract. Since

2. The most intense harmonic (or harmonics, if two were equally intense), occurred as part of the lower concentration of harmonics.
3. In 16 of the 18 samples, a concentration of harmonics occurred between 2000 and 4000 Hz (second common formant area).[76]

After determining the similarities, I then went about filtering out these areas and assessing the difference their absence made to the overall sound quality. In the case of formant area one, when absent, there is a drastic difference in 100% of the samples. (Appendix 2 lists the filters I used in this process; please refer to it throughout this discussion.)

Occurring within this first shared formant area is the most intense harmonic(s) of each sample. Concerning this area, using auditory perception to estimate the degree of difference, I found that in 14 of the 18 samples (78%) these individual harmonics contributed significantly to the sound quality of the sample. It is important to note, however, that the most intense harmonic in each sample differed. **[Example 2]** illustrates how I used a spectrum to identify the most intense harmonic or harmonics. The most intense harmonic will appear as the tallest frequency in the image.

In terms of common formant area two (between 2000 and 4000 Hz), when absent, this formant area slightly diminished the resonant quality in the voices but did not alter the vowels or the volume. If removed, the sound of the callers' voices remains recognizable, and only in 12 of the 16 samples filtered (those that contained this formant area) does the voice quality perceptibly alter. Thus, out of the 18 original samples, in 67% of them the removal of this formant area created a noticeable difference.

After ascertaining the contribution of this formant area, I then decided to determine the extent to which individual harmonics in the formant area occurring between 200 and 2000 Hz influenced the sound quality. This process involved removing each individual harmonic in formant area one and comparing the resulting sound with the original sound. I found that within this formant area the individual harmonics did contribute to the sound quality, with particular regards to the vowel shape, but that the harmonics within each sample behaved differently from one sample to the next. However, removing the various overtones did often result in increased nasality of the vowel sound.

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the vocal cords lie beneath the vocal tract that determines the vowel, the same vowel can be sung on any pitch. Thus the two functions of pitch and timbre are independent.

[76] Appendix 1 offers the specific details on all of these frequency areas.
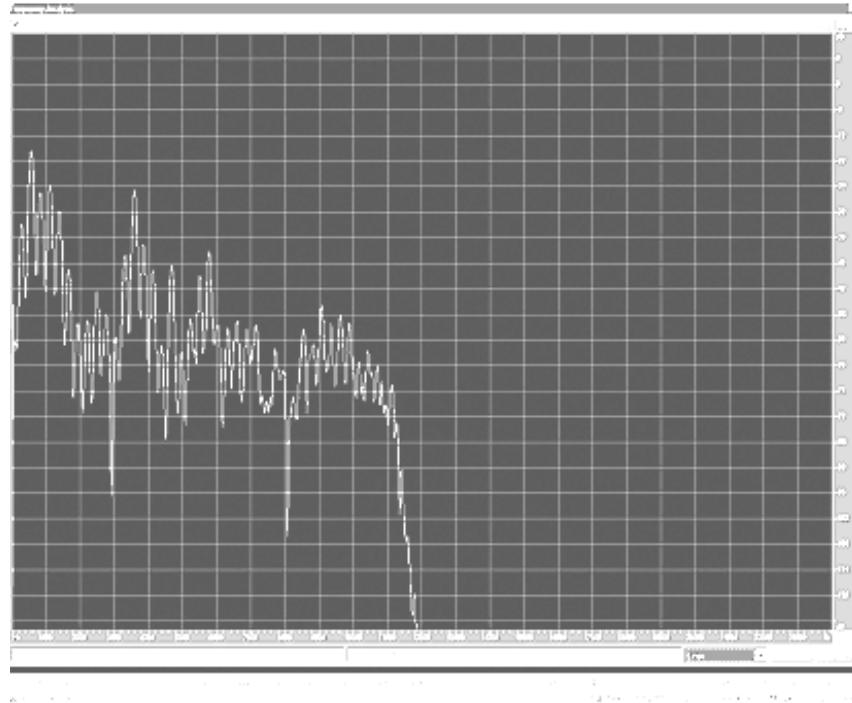
Example 2. Spectrum Indicating the Most Intense Harmonic at One Moment in Time.

As a final step, I also combined the formant area occurring between 2000 and 4000 Hz with the most intense harmonic or harmonics and removed both simultaneously. In 13 of the 18 (72%) samples, this combination resulted in an increased difference of sound when compared to either removing only the most intense harmonic or the upper concentration of harmonics.   This process leads me to believe that harmonic areas may be acting in tandem in order to create a particular timbral quality and that one particular formant area or harmonic is not necessarily responsible for a general sound quality.

SECOND METHOD: STEPS OF ANALYSIS

I found the results from the first analytic method to be inconclusive and continued my investigation with the study of onset and transition. By this I

refer to the way in which a voice begins a phrase and moves from one syllable to another. I studied this phenomenon in the call to prayer by assessing the onset of the word *Allah* and its treatment in the first and the second phrases of each sample. First, I determined the amount of time each *mu'adhdhin* devoted to this word, and then I systematically divided the word into the following components and determined how much time was spent on each component. These components are:

- [?] (initial glottal attack) [*a*]
- transition to the [*l*]
- amount of time spent voicing the [*l*] consonant
- transition to the elongated [*a*]
- amount of time spent on the [*a*] vowel
- transition to the [*hu*]
- amount of time spent on [*hu*][77]

The results of this process are listed in Appendices 3 and 4. I was particularly interested to see whether any commonalities existed in how the periods of transition, known as transients or formant transients, were treated. Transients are known for their ability to affect the perception of the syllable that follows them. As to the study I conducted, I could find few commonalities in the treatment of the onset of pitch and the transients in the word *Allah*. This is particularly true of the initial *Allah* that begins the call to prayer. The *Allah* that begins the second phrase does, however, show some commonality in that, from the initial glottal attack through the voiced [*l*] consonant, 76% of the samples devote between 0 and 10 percent (of the total time for the word [*Allah*]) on the glottal [*a*], the transition to the [*l*], and the [*l*] each, respectively, before transitioning to the elongated [*a*]. They do not necessarily move in the same directions, however, in terms of time spent on each component of the syllable, i.e. sample one moves from more time on the glottal [*a*], to less time on the transient to [*l*], whereas the opposite is true of sample two. Thus, at this point I argue that the manifestations of onset and transition in the different samples share few significant commonalities.

CONCLUSIONS

Concerning the first method I employed, I believe I might have been testing how an [*a*] vowel is formed as opposed to discerning any frequency area particular to the Islamic call to prayer. Hence, I explored another

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[77] The [*hu*] syllable reflects the subject case ending. In classical Arabic, the ends of words vary according to case.

method of evaluation. In this method, the comparison of onset and transition, I find that I have been able to obtain results that are more conclusive. The absence of significant commonalities may indicate that vocal timbre is not similar in cross-cultural production of the call to prayer. However, Professor Cornelia Fales has pointed out that perhaps I am looking at details that are too specific and suggested that I should continue my work by thinking about the acoustic needs of the call to prayer. Specifically, it is a form that requires the sound to bounce off of structures in order for it to resonate in a populated area. As such, the harmonics should be pushed towards high frequency ranges, as opposed to being concentrated near the fundamental. This is the case because sounds of higher frequency ranges will bounce off objects whereas those with lower frequency ranges will sound more easily across open spaces. A cursory examination of my samples indicates that this may be the case. In my analysis of small details, I may be missing an overriding acoustic structure which the *mu'adhdhin*-s share but within which their timbral differences exist.

At this point, I cannot say to what extent cross-culturally shared timbral features construct a sacred acoustic space, but I intend to continue my analyses in hopes of securing information that is more concrete. Further, I must admit that my research does not address another crucial aspect of timbre in the call to prayer: perception. Roland Barthes argues that it is impossible to describe a voice using scientific data because ultimately it is the sensual relationship between the listener and the vocalist that defines what he calls the "grain of the voice" (1985: 184). This relationship between listener and *mu'adhdhin* is perhaps the key to real understanding of timbre and its affective ability, and is a dimension of study that must be included for the overall analysis to legitimately reflect a functional cultural aesthetic.

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DISCUSSION

Audience #1 (Robert Reigle): Could you talk a bit more about the performance? That's kind of a complicated issue. For example, in the [a] vowel, is there also a particular frequency that is typical of the [a] sound?

Eve McPherson: Yeah, I'm really glad you asked me that, I cut things a little bit short, but I have a schematic of sort of a composite [a], and you can see, if you look at the data I gave you, that there are definitely some correlations. Now this is—not everybody's exactly the same—but this is generally where things will occur. You see where the formants are here. I found that, in my research, mostly, it looked like this was one formant, and this particular composite defines it as two. But these differences will happen. For me what's going to be interesting, and I've talked with Professor Fales, is with the information that I've collected on the [a], I'm going to be able to see how much further above the general place it usually exists it has been pushed, compared to see if those harmonics are being pushed up, in terms of acoustic resonance against buildings.

RR: So if it's pushed up does it then evolve into a different vowel?

EM: That's a good question. I think that certain components have to be there and it's going to be perceived as an [a], do you want to answer that, because you know more about the vowels?

Audience #2 (Cornelia Fales): Very definitely it will, but ultimately what happens is that in Western singing there is a lot of manipulation in performance because it helps with the amplification of the sound over an orchestra, let's say. What happens is that they find just through experience

that it can be radically distorted, but if it's in context and because it's a text that everyone knows really well, you tend to hear it the way it would be spoken even though it's off kilter a little bit.

EM: It's very interesting because in the voice, it's very rich to look at what's happening; you have the component of language shaping the sound and then you have the pitch as well, and they exist almost separately.

Audience #3 (Cevdet Erek): I didn't listen to the first part, but I wonder about the data in the sound files. How were they recorded?

EM: I pointed that out. They're field recordings, they're unamplified, but they're done by different people and it's a problematic part against the case study and I'm looking at how to use methodologies because they do need to be recorded in the same way really for you to know that you're getting the same acoustic information.

CE: So you did so, then?

EM: What's that?

CE: Did you do so in similar conditions, or ...?

EM: No, I didn't do the recordings. It's based on fieldwork of other people.

CD: Okay. Is it new field recordings, or in the original place?

EM: It's done in the field, in the original place, as far as my data is telling me. I'm not there so there are some things I can't know. But, as to the exact environment and recording equipment being used by the researcher, it's going to differ.

CE: Okay. As I can guess, this *ezan* is thinking some special character with the space, because even here in Istanbul, in big mosques, in crowded places, or in some places where we have many mosques, the *ezan* is having some different personalities. It's not in terms of being loud or not, but also it changes, sometimes. So I wondered if that thing is a related factor in the recording.

EM: I think it would be. That's why I mentioned at the end, that what I'm finding are the differences.

CE: Yes.

EM: What may be interesting there is to see what environmental factors, historically, have influenced a more basic structure. I'm talking about a very basic level whereas everything else would be dependent on a lot of other factors—the person doing it, their background, their current environment. But I think that it's possible, particularly having talked with Professor Fales about this, there are some stylistic things, with the analysis of how long transients are being used. That would be interesting to see if there are commonalities. Now I didn't find anything that I thought was particularly common, but if we're talking about the idea of wanting something that

bounces off sound, that's something that may, in fact, transcend a lot of that because it's basic enough. And that's where I went wrong—not looking at that, but I would agree with you. It's a problematic study in some ways, it's very interesting, and it's really neat to go through these methodologies and it's a very rich area because of the differences. But yes, I would agree with you.

Appendix 1. Samples and Intense Areas of Harmonic Activity

#	Location	Pitch	Fundamental Frequency	Most Intense Harmonics		Formant 1		Formant 2		Formant 3	
						low	high	low	high	low	high
1	Uzbekistan	C#	277.89	562.50		281.2	1406.0	3093	3656	5625	6750
2	Morocco	C#	270.30	562.50		271.2	1369.0	3281	4078	5437	5718
3	Turkey	C#	271.91	796.80		796.0	1359.0	2625	4218		
4	Liberia	C	268.65	750.00		234.3	1546.0	2578	3843	6187	6703
5	Tunisia	C#	275.66	281.20	562.5	281.2	843.7	3046	3843		
6	Tunisia	C	257.58	515.60		234.3	1031.0	3093	3890		
7	Egypt	C#	275.86	562.50		281.2	1125.0	3328	3890		
8	Egypt	B	248.98	703.10		234.3	937.5	2859	3200		
9	Egypt	B	242.21	703.10		234.3	1171.0	3515	4031		
10	Egypt	C#	278.19	1171.00		281.2	1171.0	2671	4171		
11	Turkey	C	262.00	1031.00		281.2	1031.0	1593	1828		
12	Turkey	C	262.34	750.00		515.6	1031.0	1546	2062	4359	4687
13	Saudi Arabia	D#	307.34	609.30		328.0	1546.0	2718	3937		
14	Saudi Arabia	C	261.70	750.00		515.6	1500.0	2296	2531	3796	4031
15	Jerusalem	C#	277.44	562.50	1125.0	281.2	1125.0	3046	3609	6375	6375
16	Pakistan	C#	275.17	562.50		281.2	1125.0	3140	3984		
17	Kuwait	C#	291.09	1171.00		281.2	1500.0	2343	3468	4640	5000
18	Indonesia	C#	283.65	1171.00		562.5	1171.0	3187	4312		

181

Appendix 2. Filters Used to Remove Harmonics in the Study of Salient Features of Voice Quality for the [a] Vowel

#	Location	Cut Off[1]	Most Intense Harmonic	Formant 1	Formant 2	Formant 3
1	Uzbekistan	LP 10K	500-600	HP 1500	3000-4000	5500-6800
2	Morocco	LP	500-600	HP 1500	3000-4000	5000-6000
3	Turkey	LP 9.5K	750-900	750-1500	2500-4200	
4	Liberia	LP 12K	700-800	HP 1650	2400-4100	6000-6800
5	Tunisia	LP 7K	HP 570	HP 1000	2900-4200	
6	Tunisia	LP 6K	500-600	HP 1000	3000-4000	
7	Egypt	LP 10K	500-600	HP 1200	3200-3900	
8	Egypt	LP 10K	650-800	200-1000	2500-3200	
9	Egypt	LP 9K	650-800	HP 1300	3400-4200	
10	Egypt	LP 10K	750-900	200-1700	2100-3000	3700-4900
11	Turkey	LP 9K	950-1150	HP 1100	1500-1900	2800-3700
12	Turkey	LP 9K	700-800	500-1100	1500-2100	4200-5000
13	Saudi Arabia	LP 8K	550-700	300-1600	2600-4100	
14	Saudi Arabia	LP 9K	700-800	500-1600	2100-2600	3700-4100
15	Jerusalem	LP 9K	500-600, 1050-1200	HP 1200	2900-3700	6000-7000
16	Pakistan	LP 8K	500-600	HP 1200	3100-4000	
17	Kuwait	LP 10K	1100-1200	250-1200	2200-3600	4000-5000
18	Indonesia	LP 7.5K	1100-1200	500-1300	2900-4500	

[1] When referring to the filters, a "low pass" (LP) indicates that any frequencies below the frequency listed were allowed to remain, while all frequencies above were removed. A "high pass" (HP) filter indicates the reverse. I also utilized what is known as "band stop" filtering in which a range of frequencies, for example between 3000 and 4000 Hz, are removed. Band stop filtering is particularly useful in analyzing formants.

Appendix 2 (cont.). Filters Used to Remove Harmonics in the Study of Salient Features of Voice Quality for the [a] Vowel

#	Location	Independently Removed Harmonics of Formant One			
		Formant 1a	Formant 1b	Formant 1c	Formant 1d
1	Uzbekistan	HP 300	800-900	1100-1200	1400-1500
2	Morocco	HP 300	700-850	1000-1100	1300-1400
3	Turkey	1060-1100	1250-1400		
4	Liberia	HP 300	500-1100	1200-1300	1500-1600
5	Tunisia	HP 300	500-600	800-900	
6	Tunisia	HP 300	750-850	1000-1100	
7	Egypt	HP 300	800-900	1050-1200	
8	Egypt	HP 300	400-500	900-1000	
9	Egypt	HP 300	400-500	900-1000	1100-1200
10	Egypt	HP 300	500-600	1000-1100, 1550-1650	1300-1400
11	Turkey	HP 300	500-600	800-900	
12	Turkey	500-600	1000-1100		
13	Saudi Arabia	300-400	850-1000	1150-1300	1400-1600
14	Saudi Arabia	450-600	1000-1100	1250-1350	1400-1600
15	Jerusalem	HP 300	500-600	800-900	
16	Pakistan	HP 300	800-950	800-950	
17	Kuwait	HP 300	500-600	500-600	
18	Indonesia	500-600	700-900	700-900	

Appendix 3. Onset for First "Allah" (% = Percentage of Total Time)

#	Location	Total Time[1]	Glottal [a]		Trans to [l]		[l]	
			Time	%	Time	%	Time	%
1	Uzbekistan	0.533	0.053	09.94	0.054	10.13	0.097	18.20
2	Morocco	3.332	0.059	01.77	0.107	03.21	0.033	00.99
3	Turkey	0.598	0.053	08.86	0.076	12.71	0.062	10.37
4	Liberia	0.523	0.061	11.66	0.052	09.94	0.041	07.84
5	Tunisia	2.362	0.041	01.74	0.043	01.82	0.046	01.95
6	Tunisia	1.110	0.119	10.72	0.270	24.32	0.182	16.40
7	Egypt	0.677	0.078	11.52	0.043	06.35	0.083	12.26
8	Egypt	0.483	0.053	10.97	0.048	09.94	0.061	12.63
9	Egypt	0.438	0.060	13.70	0.034	07.76	0.058	13.24
10	Egypt	0.594	0.088	14.81	0.076	12.79	0.051	08.59
11	Turkey							
12	Turkey	0.470	0.060	12.77	0.063	13.40	0.022	04.68
13	Saudi Arabia	5.290	0.031	00.59	0.041	00.78	0.109	02.06
14	Saudi Arabia	4.633	0.000	00.00	0.000	00.00	0.000	00.00
15	Jerusalem	0.351	0.049	13.96	0.028	07.98	0.064	18.23
16	Pakistan	4.157	0.049	01.18	0.077	01.85	0.151	03.63
17	Kuwait	0.839	0.054	06.44	0.078	09.30	0.174	20.74
18	Indonesia	0.628	0.046	07.32	0.108	17.20	0.059	09.39

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[1] Times are given in seconds.

184

Appendix 3 (cont.). Onset for First "Allah" (% = Percentage of Total Time)

#	Location	Trans to [a]		[a]		Trans to [hu]		[hu]	
		Time	%	Time	%	Time	%	Time	%
1	Uzbekistan	0.049	09.19	0.144	27.02	0.084	15.76	0.048	09.01
2	Morocco	0.070	02.10	2.874	86.25	0.148	04.44	0.037	01.11
3	Turkey	0.187	31.27	0.063	10.54	0.110	18.39	0.045	07.53
4	Liberia	0.075	14.34	0.149	28.49	0.025	04.78	0.116	22.18
5	Tunisia	0.120	05.08	2.020	85.52	0.059	02.50	0.039	01.65
6	Tunisia	0.070	06.31	0.064	05.77	0.119	10.72	0.282	25.41
7	Egypt	0.207	30.58	0.105	15.51	0.073	10.78	0.085	12.56
8	Egypt	0.043	08.90	0.113	23.40	0.106	21.95	0.056	11.59
9	Egypt	0.120	27.40	0.042	09.59	0.051	11.64	0.071	16.21
10	Egypt	0.115	19.36	0.048	08.08	0.103	17.34	0.109	18.35
11	Turkey								
12	Turkey	0.101	21.49	0.081	17.23	0.078	16.60	0.065	13.83
13	Saudi Arabia	0.791	14.95	4.072	76.98	0.072	01.36	0.171	03.23
14	Saudi Arabia	0.738	15.93	3.714	80.16	0.045	00.97	0.135	02.91
15	Jerusalem	0.044	12.54	0.091	25.93	0.038	10.83	0.035	09.97
16	Pakistan	0.432	10.39	3.087	74.26	0.134	03.22	0.224	05.39
17	Kuwait	0.150	17.88	0.202	24.08	0.108	12.87	0.070	08.34
18	Indonesia	0.083	13.22	0.163	25.96	0.116	18.47	0.049	07.80

Appendix 4. Onset for Second "Allah" (% = Percentage of Total Time)

#	Location	Total Time	Glottal [a]		Trans to [l]		[l]	
			Time	%	Time	%	Time	%
1	Uzbekistan	2.192	0.070	03.19	0.024	01.09	0.134	06.11
2	Morocco	3.663	0.045	01.23	0.162	04.42	0.101	02.76
3	Turkey	0.564	0.062	10.99	0.084	14.89	0.031	05.50
4	Liberia	2.224	0.035	01.57	0.103	04.63	0.191	08.59
5	Tunisia	2.362	0.041	01.74	0.043	01.82	0.046	01.95
6	Tunisia	1.110	0.119	10.72	0.270	24.32	0.182	16.40
7	Egypt	0.677	0.078	11.52	0.043	06.35	0.083	12.26
8	Egypt	0.483	0.053	10.97	0.048	09.94	0.061	12.63
9	Egypt	0.438	0.060	13.70	0.034	07.76	0.058	13.24
10	Egypt	0.594	0.088	14.81	0.076	12.79	0.051	08.59
11	Turkey							
12	Turkey	0.470	0.060	12.77	0.063	13.40	0.022	04.68
13	Saudi Arabia	5.290	0.031	00.59	0.041	00.78	0.109	02.06
14	Saudi Arabia	4.633	0.000	00.00	0.000	00.00	0.000	00.00
15	Jerusalem	0.351	0.049	13.96	0.028	07.98	0.064	18.23
16	Pakistan	4.157	0.049	01.18	0.077	01.85	0.151	03.63
17	Kuwait	0.839	0.054	06.44	0.078	09.30	0.174	20.74
18	Indonesia	0.628	0.046	07.32	0.108	17.20	0.059	09.39

Appendix 4 (cont.). Onset for Second "Allah" (% = Percentage of Total Time)

#	Location	Trans to [a]		[a]		Trans to [hu]		[hu]	
		Time	%	Time	%	Time	%	Time	%
1	Uzbekistan	0.272	12.41	1.448	66.06	0.119	05.43	0.122	05.57
2	Morocco	0.061	01.67	3.133	85.53	0.106	02.89	0.050	01.37
3	Turkey	0.096	17.02	0.104	18.44	0.117	20.74	0.070	12.41
4	Liberia	0.072	03.24	1.694	76.17	0.094	04.23	0.032	01.44
5	Tunisia	0.120	05.08	2.020	85.52	0.059	02.50	0.039	01.65
6	Tunisia	0.070	06.31	0.064	05.77	0.119	10.72	0.282	25.41
7	Egypt	0.207	30.58	0.105	15.51	0.073	10.78	0.085	12.56
8	Egypt	0.043	08.90	0.113	23.40	0.106	21.95	0.056	11.59
9	Egypt	0.120	27.40	0.042	09.59	0.051	11.64	0.071	16.21
10	Egypt	0.115	19.36	0.048	08.08	0.103	17.34	0.109	18.35
11	Turkey								
12	Turkey	0.101	21.49	0.081	17.23	0.078	16.60	0.065	13.83
13	Saudi Arabia	0.791	14.95	4.072	76.98	0.072	01.36	0.171	03.23
14	Saudi Arabia	0.738	15.93	3.714	80.16	0.045	00.97	0.135	02.91
15	Jerusalem	0.044	12.54	0.091	25.93	0.038	10.83	0.035	09.97
16	Pakistan	0.432	10.39	3.087	74.26	0.134	03.22	0.224	05.39
17	Kuwait	0.150	17.88	0.202	24.08	0.108	12.87	0.070	08.34
18	Indonesia	0.083	13.22	0.163	25.96	0.116	18.47	0.049	07.80

THE TIMBRE OF ANCESTRAL SPIRITS
IN A NEW GUINEAN VILLAGE

Robert Reigle

I lived in Serieng village, Papua New Guinea, for three years. People in Serieng speak the Nekeni language, a language group with about 1,200 speakers living in seven villages. The villages start on the coast and weave inland to an elevation of about 450 meters. Each village has only 100 to 120 people. The Nekeni language is a Trans-New Guinean or Indo-Pacific language (Gordon 2005 lists this language as "Nekgini"), and the ancestors of present-day Nekeni speakers arrived in New Guinea in one of the waves of settlement beginning approximately 55,000 years ago. Until about 5,000 years ago, there were groups coming that had originated in Taiwan, and spoke Austronesian languages.

The language families are pertinent in this discussion because the Nekeni word for their traditional religion is, I believe, an Austronesian word, even though the Nekeni people are non-Austronesian. People of Serieng village have a religion called *Kaapu*, a term cognate with some of the most important Austronesian terms denoting sacredness. In Nekeni language, the term *Kaapu* encompasses the religion, spirit, sacred music, and sacred musical instruments. The Austronesian cognate *tabu* has entered the English language as "taboo." In some Austronesian languages (for example, Samoan) t and k are interchangeable. This, together with the close relationship between the sound of p and b supports the idea of an Austronesian origin of, or influence on the Nekeni term *Kaapu*. If that hypothesis is correct, then the Nekeni either adopted an outside religion or modified their religion with Austronesian ideas. In either case, the arrival of the Austronesians would have marked an important change in the history of Nekeni religion.

Nekeni based their religion, *Kaapu*, on a gender balance (although one could argue that the balance is an imbalance). According to legend, the women first controlled the spiritual essence or the power, and this power existed in musical instruments. The women kept these instruments and

played them, but the men heard them and both the men and the women agreed that the sound was terrible—the women didn't play them right; inside the house where they played them it was dirty. Therefore, both the men and women agreed that the men would take these instruments and play them. Not only would they play the instruments, but they would also forbid the women and children from seeing the instruments, and if a woman looked at the instruments, surrounding villages would kill her whole village. It was a strict taboo, still maintained today. As far as I know, the last time a village suffered such a fate was around the first decade of the twentieth century. They would follow an elaborate process. The surrounding villages would plan the attack, the offending village preparing for the event. The big man of the village would stand in the center, surrounded by concentric circles of gradually less important people, with the women and children on the outside. People from Serieng showed me some human bones and said that a massacre took place there. Three such places exist within a three-hour walk from where I lived. In earlier times, villages were different. Most people lived in clans or family groups at that time. When the Australians came they made everybody live together; instead of individual family groups living separately, there are now about five or six "clans" living together in one location.

This is the legend, and it is remarkably similar to a sacred legend in the Brazilian Amazon, among the Enauene-Naue people. Both cultures share the exact same legend, have some of the same instruments, use cognate names for some of the instruments, and perform similar melodies. These instruments are voice modifiers, the specific varieties of which are very rare in the world. One of them sounds like a kazoo, is about 35 centimeters long, and is made of cracked bamboo; the performer puts one end in his mouth and sings through it. In the village where I lived, they stroke it to get the buzzing sound to come out. This instrument also exists among the Enauene-Naue, where it has the exact same name, *tereri* (Fernandez 1995). In fact, the people from surrounding villages came to me asking to hear the tape recording of this music from Brazil, because they couldn't believe that people so far away could have something so similar to theirs. They would actually identify particular songs, saying which Enauene-Naue song sounds exactly like which Nekeni song. (An anthropological conference in San Diego explored some of the remarkable gender and religious parallels between the Amazon and New Guinea. See Gregor and Tuzin 2001.)

The men still today forbid the women from viewing these secret instruments, and yet there is an ambiguous amount of complicity among the women. For example, older women may not only see the instruments, but

they actually grow the gourds used to make them (although the instruments last for decades, thus minimizing the number of women who would ever grow such gourds). During the three years I lived in the village, the men never revealed to me the extent to which the younger women have gotten glimpses of the instruments or know what they are, and obviously I could not in good conscience ask men or women directly.

The purpose of the instruments, then, is to create a numinous sound associated with ancestor spirits, and enable men (rather than women) to maintain control of the religion. In Serieng village, the five clans own a total of 35 *Kaapu* (sacred songs); each clan has six or seven sacred songs. Seriengs may hum the melody any time they wish, or sing it while they work. They cannot use the sacred instruments, however, unless they have a ritual where they kill a pig and offer pig meat to the ancestor spirits. If they fail to do this, somebody in the village will probably get sick, or it could cause women to be barren, or some kind of bad fortune for the village.

The men who created Nekeni religion had to find numinous sounds— sacred sounds distinct from the natural environment, so they devised several kinds of voice modifiers. Most of New Guinea has tropical foliage, and one hears many insects all the time. The sounds that people hear all day long are actually quite loud; it is not at all a quiet place. The numinous sounds also had to be loud, so that men and women could hear them above the environmental sounds.

Nekeni people call the instrument in this example "the child of the spirits," *Kaapu simang*. It is a voice modifier consisting of an eight-foot bamboo open at both ends, with no finger holes; the sound comes from the voice. Men put their lips on the outside of this quite large bamboo, and then sing in a falsetto range. The high tessitura is consistent with that of a human child's voice, and thus with the name of the instrument. On the other hand, the "mother of the spirits" (*Kaapu naing*), ostensibly female, actually has a deep voice, at the very bottom of the male voice range. The *Kaapu naing* is the most important voice modifier, and indeed constitutes the central repository and symbol of Nekeni traditional religion (*Kaapu*). Nekeni men keep these instruments for decades, treasuring and loving them. Some villages still have spirit houses forbidden to women, where they keep *Kaapu naing*. In villages that no longer maintain a spirit house, the men keep the sacred instruments in a boys' house, a house used by unmarried boys, and forbidden to women with the exception that women past the child-bearing age may enter to clean the house.

I convinced one of the men to sing what he normally sings, but without the instrument, and then I compared the unmodified voice with the exact

same moment using the instrument, based on short slices of the recordings lasting 16 hundredths of a second. That analysis shows how the instrument modifies the relative strengths of the partials and amplifies the sound, working as both a megaphone and a tone-color changer (Reigle 1997).

The recorded example referred to above, illustrates the way that the *Kaapu* sound cuts through the sounds of the jungle, through the insects and birds. This sound has to reach the women, who must periodically hear the sound of the spirits in order to continue to believe that the spirits control their lives. Evidence that the spirits exist takes sonic, visual, and event forms. In addition to the spiritual sound of the *Kaapu*, Nekeni sometimes identify spirits as the source of a distant light (there is no electricity in the Nekeni area), or as the cause of a person's illness.

Combining mystic experience and human will, I believe, Nekeni men sought a mechanism for demonstrating the spiritual presence of ancestors while asserting their own control (human, but also infused with *Kaapu*) of such forces, to the exclusion of women. Sound offered advantages such as the ability to cover a large physical space, inspire awe, precipitate an esthetic experience, and remain within the control of men. In order to create a sound that both men and women would experience as a spirit, they needed something that contrasted with the environment, radically different from any sound heard in normal, daily life. Perhaps because the sound represented ancestor spirits of humans, they included the human voice as an essential component. Still today, Nekeni men use three different instruments with which to carefully shape and transform their human voices into spirit sound, *Kaapu*.

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DISCUSSION

Audience #1: Is there a particular reason why their instruments are pointed to the ground? Do they use any reflections, or would it sound different if they were pointing up?

Robert Reigle: The instruments are mobile, so this gourd instrument is used in dancing. So I think the fact that it's pointed to the ground is an artistic choice. It needs to not be pointed straight down, otherwise the sound wouldn't be loud enough. It's designed as a megaphone; the good sound is the loud sound. Same with the long bamboos, which are actually not played in the village. They're played about a ten-minute walk from the village, but the women can hear them in the village even at that distance. When they play those, typically they're kind of resting on the ground but they usually sort of swing them around a little bit. But it doesn't seem to make much difference in terms of the volume, the fact that they're pointing to the ground.

A#1: Thank you. How much does one of these instruments weigh, approximately?

RR: The bamboo is not too heavy and the gourds are very light, made out of several gourds that are glued together in sections.

Audience #2: You said that the women are not allowed to see but only to hear them; they are supposed to be reminded of the spirits every so often. Is that a sort of use of power, then, from the men over the women, or what do you think that is?

RR: It's a complicated question, the whole gender thing. In terms of daily life, it seems like there's a fairly equitable balance. But now it's different than it was in those times. In traditional times, the men were spending a lot of time doing warfare and the women were basically doing all the work. The men would do the heavy work of clearing the gardens, but then for the rest of the season the women were doing most of the work, and the men were free to do warfare and ritual. Originally, the men tricked the women in order to get the pig meat; pigs were scarce and valuable, so the women would actually offer the meat to the spirits by putting it in front of the spirit house, then the men would take it and eat it. Nowadays they still have to kill the pig and they still ritually offer it to the spirits, but now they distribute it equally among the men and women.

A#2: But aren't there villages where the men and the women live separately and the pigs are with the women?

RR: There are, especially in the highlands, in fact sometimes women suckle pigs at their own breast; they treat them like their own children. But where I was living the men and women are living together.

Eve McPherson: You said that you convinced someone to sing without the instrument. Was that difficult? Is there a conflation with the instrument and the voice, do they see the voice as an instrument?

RR: It wasn't difficult morally, it's just that it was an odd request that he'd never thought of before. First they said no, no, no, and I said why not, why not? It's just that they hadn't thought of it, and they were a little embarrassed as well, but there was no moral or religious question.

Nilgün Doğrusöz: Is there a certain age for children to start playing this instrument?

RR: Yes, it varies, usually when they're eight or nine they can start, but they would never do it in public because it might sound bad and reveal what the instrument is. Where I was living they also have a circumcision initiation, which is actually a recent addition that's only about 60 years old. This is a special time where they do have a pig to kill, so the instruments are "on," they're allowed to play the instruments. Today that's one of the main times where children actually learn to play the instruments. Circumcision can be anywhere from age seven to age 25. In fact, when I was there, there was a young man who had gone to the capitol city, Port Moresby, and was studying to be a medical practitioner, and he came home and did the circumcision initiation at age 25.

ND: Was it easy for them to accept you as a researcher at the beginning?

RR: Yes. In New Guinea, people are eager to have guests, and honored that someone from overseas would be interested in their culture. Three months after I got there a family adopted me formally into their family.

Cornelia Fales: Of the spectra that you showed, which was the flute and which was the voice?

RR: The top one is the voice, and the bottom one is the modified voice. It kind of cleans up the partials.

CF: It also turns it into a pipe closed on one end; you only have odd harmonics there, so it goes from a flute to a panpipe.

RR: Yes. It's really a remarkable sound. They have incredible voices; they can sing like this all night long. They're at the very top of the falsetto range, and it's extremely loud. After two minutes I was exhausted and couldn't do it any more. But they have very strong voices.

A#2: In the abstract you mentioned "the dual agency—spirit and human—of spirit voice production." I couldn't get this expression, could you please explain it?

RR: That's a very good question. What I mean is, is the source of the voice the man who is singing, or is it the spirit? They were very emphatic that the sound is a spirit voice, so I would say, but you're singing it, so isn't it your voice? They would say, yes it is my voice, but it's the spirit voice. In our logic, these things can't both co-exist, but to them it's absolutely a spirit voice.

EM: Does that apply to the women's perception too, do they know it's the men singing when they hear this?

RR: That's the question of the ambiguity. I think a lot of women recognize particular singers, they can usually tell whose voice they're hearing. But I never really solved that question of, to what extent do the young women know exactly what's happening. But definitely the older women can tell who's singing.

A#2: So in your opinion, is the voice a kind of motivation, or an instrument?

RR: I think of the voice as the medium. They really say that it is the ancestor voice. The fact that these ancestors can cause illness and death is convincing to me that they are absolutely dead serious about that. There was a man who was ill, in another village. They assumed that an ancestor spirit caused it. So people from our village went there, did a ritual, and called out to that spirit and said, "Okay, we know why you're mad at us, but please excuse us, forgive us for what we did, and let this person be healthy again." Then the person became healthy again. The voice is like a medium for the spirit voice, but it's not like possession, it's not like the person is possessed by the spirit, it's just that the sound that comes out that the women hear is an ancestral spirit.

A#3: Is there a special reason why pigs, but not other animals, are killed before the ceremonies?

RR: It's just a practical thing. Pig is the most valuable and most desirable food, and it's also quite scarce. It just makes sense even for survival; it's the main meat, the main source of protein. It's just the most desirable food.

EVOKING TRADITIONAL SOUNDS THROUGH
TIMBRAL INNOVATIONS

Kathryn Woodard

The impetus behind presenting this lecture-recital at the Istanbul Spectral Music Conference was to demonstrate a variety of techniques that composers have used to change the timbre of the piano and to show how these changes evoke and represent traditional music and instruments of non-Western cultures.[78]

The idea of evoking the "other" is, of course, not new to piano music, and has a long history among Western composers from the *Rondo alla turca* of Mozart to the gamelan-influenced works of Claude Debussy. What is different about the works on this program is each composer's use of timbre and timbral changes on the piano in order to create perceptual representations of different styles of music. Another important difference is that two of the composers are from the cultures they seek to represent— Franghiz Ali-Zade is from Azerbaijan and GE Gan-ru is from China—which necessarily changes the discussion from simply a Western view of the "other" to a dialogue between East and West that takes place on the piano. I thought this topic was particularly relevant for a presentation in Istanbul, where the expression "East meets West" is not simply a tired catchphrase but an actual description of influence and cross-cultural dialogue.

Although timbral explorations may be relatively new to the piano repertoire, the idea of employing timbre as a tool for representation is not new. I am thinking specifically of the phenomenon of sound mimesis as studied by Steven Feld among the Bosavi people of Papua New Guinea and by Theodore Levin in Tuva and Mongolia. I have been particularly influenced by Levin's work, and would like to offer a few of his insights into sound mimesis and timbral listening as a way to open my discussion of timbral representations on the piano.

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[78] This paper was presented as a lecture-recital of works by John Cage, Franghiz Ali-Zade, GE Gan-ru, and Kathryn Woodard.

In his book *Where Rivers and Mountains Sing: Sound, Music and Nomadism in Tuva and Beyond,* Levin discusses how Tuvan music is timbre-centered, including the well-known style of throat-singing, and is used to create mimetic representations of nature and natural soundscapes such as valleys, rivers, and caves. Levin collaborated on the book with Tuvan scholar Valentina Süzükei, who shares the following perspective on the Tuvans' concept of timbre-centered listening:

> Westerners who listen to drone-overtone instruments like the jew's harp, or to throat-singing, often ignore the drone and focus only on the melody. But for Tuvan listeners, drone and overtones form an inseparable whole, and the timbre of the drone is crucial to producing a harmonically rich sound that extends over a wide frequency range. (Levin with Süzükei 2006: 50)

Through his continuing fieldwork Levin also came to the conclusion that when Tuvans speak of "melodic richness [what is] meant [is] timbral richness" (2006: 50), that is, a rich fundamental tone that can change in timbre as opposed to creating an explicit sequence of pitches that form a melody.[79]

Related to timbre-centered listening is the phenomenon of sound mimesis, which Levin approaches from a variety of perspectives including research into human cognition. He draws on the work of Merlin Donald, who makes distinctions between mimicry, imitation, and mimesis as different cognitive stages and capabilities, in his book, *Origins of the Human Mind*. The following excerpt from Levin's book refers to Donald's definitions:

> "Mimetic skill or mimesis," says Donald, "rests on the ability to produce conscious, self-initiated, representational acts that are intentional but not linguistic." Donald distinguishes between mimicry, imitation, and mimesis … Mimicry is "literal, an attempt to render as exact a duplicate as possible," and Donald notes that "many animals possess some capacity for mimicry." Imitation is less literal than mimicry in Donald's trichotomy, and is common among monkeys and apes. Donald provides the example of offspring copying a parent's behavior, in which the copying involves imitation but not mimicry. Mimesis, by contrast, "adds a representational dimension to imitation. It usually incorporates both mimicry and imitation to a

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[79] Levin's most recent recording from the region does credit the timbre-centered nature of throat-singing and other Tuvan music. See *Tuva, Among the Spirits* (1999).

higher end, that of re-enacting and re-presenting an event or relationship," and thus involves "the **invention** of intentional representations." (Levin with Süzükei 2006: 74-75)

Levin relates these definitions to musical life in Tuva and describes "ways in which human sound-makers mimetically represent their relationship to the natural beings and forces that surround them, both in real life and in the magical-realistic world of narrative performances, where the 'voices' of musical instruments represent events in the lives of humans and animals" (2006: 78).

Although piano music may seem distant from Tuvan music both in terms of place and style, these explanations of timbral listening and sound mimesis are relevant to my discussion, since two of the pieces (those of Cage and GE Gan-ru) are created from timbre-centered sound worlds, and all of the works utilize timbre as a way to establish, represent, and express relationships. In this case the relationships are between cultures rather than between nature and humans.

In the pieces by Ali-Zade and GE Gan-ru, and in my own transcription, the idea of mimesis will be clear. To discuss the music of John Cage in terms of sound mimesis is more problematic, since his works do not give us examples of so-called "intentional representations," but rather they introduce us to different realms and aesthetics of sound where timbre figures prominently. I have included his music on the program in order to provide an example of early timbral explorations at the piano. These were innovations that had a profound influence on many later composers, including the three others represented on this program, who adopted and developed timbral techniques to serve the purpose of a **kind** of sound mimesis.

I chose to perform excerpts from *Sonatas and Interludes*, Cage's most extensive work for prepared piano. The pieces were composed from 1946 to 1948, a time when Cage was becoming aware of Oriental philosophy and specifically the work of Ananda K. Coomaraswamy, the Indian art historian and aesthetician. Cage described his intentions for the cycle of pieces: "I decided to attempt the expression in music of the "permanent emotions" [or *rasa*-s] of Indian tradition: the heroic, the erotic, the wondrous, the mirthful, sorrow, fear, anger, the odious, and their common tendency toward tranquility" (Cage 1991: 129). However, Cage scholar David Patterson states that it is "impossible to cross-match any one sonata to any one emotion … Consequently, the relation of these *rasa*-s to the *Sonatas and Interludes* seems to be an eternally murky issue" (Patterson 2003: 204).

197

Clear references to particular sound worlds, of Asia or otherwise, are not part of Cage's intentions for the pieces. However, his decision to use altered timbres of the piano does betray his interest in non-Western music, specifically the sounds of percussion instruments from around the world, to which he became exposed through studies with Henry Cowell, and which he began incorporating into his music in the mid-1930s. Although this would seem to point to an overt interest in timbre as an organizing principle in Cage's music, Christopher Shultis makes the distinction between Cage's interest in rhythmic elements of percussive music and its timbral components, the former providing the primary compositional framework for Cage and the latter being added later as a result of Cage's experimentation in performance (Shultis 2003: 90-91). So when I speak of these pieces as being timbrally centered, I am referring to this performative aspect of Cage's creative work.

Because of these "murky" references to the East, both in terms of sound and philosophy, Cage's music has been studied as a continuation of Orientalism in music, just within an experimental framework. John Corbett compares the tactics of Cage, which he labels "conceptual Orientalism," with those of other composers whose approach Corbett calls "contemporary chinoiserie." Incidentally, he makes quite a similar distinction between mimesis and imitation in his arguments, but as a means for aesthetic judgment. He states, "Unlike Cowell, Partch, and Cage, who were stimulated by non-Western musics to come up with something conceptually and/or sonically original, Hovhaness, McPhee, and Harrison tended to pay homage with the sincerest form of flattery—cheap imitation" (Corbett 2000: 173).

Although Cage does not make overt references to specific styles of percussion music in *Sonatas and Interludes*, I propose that these pieces evoke the sound of the non-Western in a non-specific sense simply because the timbre of the instrument is altered. If one does not hear the sound of the piano, then one automatically goes looking for ways to describe the "other" sounds that are presented, namely as percussion instruments from a variety of traditions. With further research into the neuroscience of imitation and mimesis, along the lines of Donald's work, maybe it will even be possible to say that it is wired into us cognitively to listen for such relationships and representations in music.

Cage's piano music had a strong influence on the music of Franghiz Ali-Zade, who was born in 1947 in Baku, Azerbaijan. She received her education at the Baku State Conservatory with degrees in piano, composition, and musicology. She became an active performer of

contemporary music and performed *Sonatas and Interludes*, as well as works by George Crumb, throughout the Soviet Union during the mid-1970s. She explained to me through recent e-mail correspondence that Cage's cycle, and American music in general, opened up a new world of sounds and timbres for her. And she specifically began to search for ways to create sounds of her country's traditional instruments using prepared piano techniques. One of her earliest pieces using these techniques is *Habil Sajahy* (In Habil's Style), from 1979 and for cello and piano, in which she conjures up the string instruments *kemancha* and *tar*, and *gosha-nagara*, the small kettle-drums of Azeri music. In *Music for Piano*, Ali-Zade's "intentional representation" is the sound of the *kanun*, or plucked zither of Azeri (and Turkish) art music, which she evokes timbrally by placing a beaded necklace over the strings in the mid-range of the piano.

Ali-Zade first performed the work in 1989, but she did not decide on a fixed notation for it until 1997. Rather, she relied on a modal framework for the piece, similar to that of Azeri music, called *mugam*, as a way to structure her performances and which allowed her the freedom to improvise, a predominant feature of such modal traditions. Both the potential for improvisation and the selection of pitch material modeled on a particular *mugam* serve as additional means for evoking the sound of Azeri music in this work. I will perform from the notated version of the score. However, having listened to Ali-Zade's own recording of the piece before she decided on the fixed notation, my performance is also informed by her original improvisatory approach to the piece, and I do allow myself liberties with melodic figuration and rhythmic phrases.

While Ali-Zade credits Cage's influence, she also sets herself apart from his "approximation of Eastern sound concepts" by claiming that she is "incorporating the European instrument into her own musical tradition" (Redepenning 1997). However, she admits that she became acquainted with *mugam* and Azeri art music quite late in her career through self-directed study. Her music, then, is an example not only of a response to Cage's experimental Orientalism, but also of dialogue within the artist herself, discovering, recreating, and representing aspects of identity.

The next composer featured on the program is GE Gan-ru, who has been called China's first avant-garde composer. He received degrees in both violin and composition from the Shanghai Conservatory of Music. In 1982, when China was still unfamiliar with twentieth-century Western music, he wrote politically controversial works, including *Yi Feng* for solo cello in which he used unorthodox extended techniques to produce timbres simulating Chinese percussive instruments. In 1983 he was awarded a

fellowship to attend Columbia University, where he completed his doctoral degree. He has since lived in the United States and has received commissions from, among many other performing bodies, the New York Philharmonic, the Tokyo Philharmonic, and the Kronos Quartet (Zhang 2001).

I performed two movements from *Gu Yue* (Ancient Music), which has four movements total, each referring to a Chinese traditional instrument—gong, *qin*, *pipa*, and drum. In these pieces, GE Gan-ru uses a variety of techniques for evoking the sound of Chinese music, and his work clearly demonstrates the principle of sound mimesis as a means to create something new while still remaining rooted in tradition.

The first piece, entitled "Gong," refers to the large bells found in Chinese temples. The bell sound is re-created on the piano with preparations and also by modifying the lowest strings to produce harmonics. Although the notation is specific as to which overtone should be produced, the resulting sound is not simply one isolated pitch, but rather a timbrally rich sound approximating that of a gong. The second piece is entitled "Qin," which is a type of Chinese zither. Although the main technique of playing this instrument involves plucking and strumming the strings, a wide variety of other sounds are also part of the instrument's tradition, and GE Gan-ru evokes these with varied extended techniques.

I recently had the opportunity to speak with GE Gan-ru about his work, and posed questions to him about his explorations of timbre. I wondered how and when he became interested in using extended techniques as a means for evoking traditional sounds. He told me that with such a strong background in Western music as a young person, he actually "looked down on Chinese music" and followed trends in twelve-tone composition in his early years. However, he realized this system did not enable him to express what he felt, and his leanings subsequently became closer to Bartók, who also looked to his own culture for inspiration. He remembers when visiting performers came to China from the West and brought scores by composers such as Cage and Crumb. This music inspired him to explore ways to represent the music of his own culture on Western instruments. In GE Gan-ru's view, such extended techniques are particularly relevant for exploring Chinese music on the piano, since that tradition is timbre-centered rather than pitch-centered. He explains the difference in hierarchies of musical elements by stating: "While in Western music, composers are concerned with relationships between **pitches**, in Chinese music what is important is the **particular** pitch [with] its microtonal and **timbral** character" (quoted in Steinitz 1992: 313). With this in mind, I want to point out the difference

between American and European composers, who used timbral effects as a way to break with pitch-centered tradition and introduce the listener to new sound worlds, and non-Western composers who rely on timbral innovations as a way to continue and reinterpret the tradition of their own country within the framework of Western instruments.

Like Ali-Zade, GE Gan-ru differentiates his music from that of Cage and others in terms of compositional approach. He emphasizes that even though Cage was receptive to the East, his music is still highly systematized and governed by logic, a characteristic which GE Gan-ru considers a predominant feature of Western thought and aesthetics, but which is opposed to the actual tenets of Eastern philosophies and artistic approaches. When I queried him about Cage's later use of chance procedures and even the *I Ching* in his compositions, GE Gan-ru answered, "even that is used in a logical and highly systematic way."[80]

The final piece on the program was my own transcription of music by Umar Temor, who is from Tajikistan. I heard his music at the Smithsonian Folklife Festival in Washington D.C. in July 2002. That year's festival was titled "The Silk Road: Connecting Cultures, Creating Trust" and was produced by the Smithsonian Center for Folklife and Cultural Heritage in partnership with the Silk Road Project.

I heard the piece with Umar Temor performing as vocalist along with a chorus, several string players, and frame drummers. The ethnomusicologist Ben Koen, who has done fieldwork in Tajikistan, provided me with information about Umar Temor, who is also a master of the spiked fiddle known as the *qaichek* or *kamanche*, and teaches Tajik folk music at the university in Dushanbe, the capital of Tajikistan. His focus is on spiritual music related to Islamic mysticism and, though clearly rooted in tradition, this devotional song and dance is an example of his own personal style. The original song text, by Umar Temor, is in classical Tajik-Persian, and the title *Bazme Rabbani* can be translated as "Spiritual Gathering" **[CD 1:4]**. The following is an excerpt:

> Let us sing praises to our Beloved[.]
> Forget the self, leave love of the world behind, and
> Host the Spiritual Gathering!
> Sing sweet, lyric poems.
> Chant verses of love.
> One travels from place to place, from ocean to ocean, imprisoned by
> the world.

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[80] GE Gan-ru, in an interview with the author, 17 September 2003.

Host the gathering of God, all are welcome![81]

It was not my intention to record something at the Folk Life Festival so that I could write a transcription of it **[CD 1:5]**. I was just so taken by this particular piece that I thought it would be worthwhile to try my hand at it. By definition a transcription is not an attempt to create something new, but rather is closer to the definition of mimic: "as exact a replicate as possible." And so, one could label my attempts as two steps back on the evolutionary scale described by Donald. However, whereas rhythms can be mimicked and melodies are closely approximated, the timbral aspects of the piece provide the mimetic challenge—that of recreating and reinterpreting the overall sound world of the piece.

I used preparations that I am familiar with from playing Cage's works and experimented to achieve a suitable timbral environment for the piece. I also used one preparation to alter the tuning of the piano and to approximate a modal shift that occurs in Temor's performance. By wedging a dime between the strings of C4 and C5, I was able to achieve additional 'A's (A4 and A5) that are approximately two commas flat from tempered tuning.[82] These pitches occur prominently in Umar Temor's vocal refrain during the third section of the piece.

A result of this transcription, of course, is that I am throwing myself into the cross-cultural dialogue regarding the evocation of traditional sounds. I have been particularly curious to know Umar Temor's impressions of my work and what he thinks of my mimetic attempts at representing his music on the piano. Unfortunately, I have not yet heard directly from Umar Temor, although Koen has relayed the message that he is very intrigued and excited by the idea.

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[81] Translation by Ben Koen provided in e-mail correspondence with the author, 18 October 2002.

[82] I learned of this technique from Paul Hogan, a composer at Columbia University.

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DISCOGRAPHY

Tuva, Among the Spirits: Sound, Music, and Nature in Sakha and Tuva. 1999. Recorded by Joel Gordon and Ted Levin. Washington, DC: Smithsonian Folkways, CD 40452.

DISCUSSION

Audience #1 (Özge Çaysever): What did you put inside the piano?
Kathryn Woodard: There are screws, rubber, bolts, leather stripping.
ÖÇ: How do you select them?
KW: Just experimentation.
Audience #2 (Bennett Lowenthal): Is there a standard for prepared piano? Did John Cage write down what you put where?
KW: Yes.
BL: Is it written down or is it photographed—how do you know?

KW: Yes, it is written down, it is very specific: what pitches, what materials, where to place them on the strings. What he is not specific about is exactly what material to use. He just says "bolt," "large bolt," "medium bolt"—what does that mean?

BL: Do you experiment with different kinds of unthought-of preparations yourself?

KW: Yeah. For example, some of the ones I used are in the transcription—so many possibilities.

Audience #3: Is the music written down?

KW: No.

A#3: Or is it just an oral tradition?

KW: Oral tradition.

Audience #4 (Hasan Uçarsu): You said for the John Cage piece *Sonatas and Interludes*, he could write experimental Orientalism. All right, what do you think about the Ali Zade and the others? Aren't those pieces experimental Orientalist in that sense—what makes them different? All right, maybe I will add some other [question].

KW: I agree. The whole essence of *mugham*, *makam*, for that matter, is the tuning system. I understand that dilemma, so approximating that on the piano, just using the Western tempered tuning, is like timbral addition. Certainly you can also call that a type of Orientalism, even though the person is coming from the East—usually when we think about Orientalism it is someone outside of the East, representing the Orient. But I want to hear very much what you have to say about that, what you think about that.

HU: Yeah, I mean, the same point as you, first of all. As you know, Ali Zade was, you know—it doesn't matter, but she trained all the way through, what you said, in the Western tradition. It's only one aspect, you know. I mean in that sense, you can't rescue her, because, you know, this music … there are other aspects of this music, as you said. The pitch system and, besides, the gestures, and, besides, the harmonies, and so on, you know. It is a big issue and questions we can talk a lot about that, and maybe can't find an answer.

KW: Does it sound any different for her to be composing in that way than an American composer? Is it different, the fact that she is from Azerbaijan? Does anyone else have something to say about that? Any other questions?

Audience #5 (Cornelia Fales): I wondered if there is any category [among] Levin's or Donald's categories of kinds of mimesis and imitation …

KW: They were Donald's. Levin is using Donald.

CF: Thank you. Whether there was a category for, again, what seems to be kind of symbolic, almost. In that the last piece you played, a big part of that

music, as I understand, is a kind of heterophony, which obviously you cannot do on the piano. So what you were doing was staggering the pitches, staggering a kind of unison for a while. And clearly that is not an imitation, really, right? Well, I don't know where you would put that in his system of categories. I think it was really effective, but whether it fits in under any of those kinds of [categories].

KW: Probably. It's a good question. Imitation. The idea of heterophony is that several people are interacting with one another, and here I am one person trying to create a whole piece. Which is the difficulty, I only have two hands.

CF: Yeah, sure. But I think you found a good technique, I mean, a good device to use [that's] as close as possible.

KW: Thank you.

CF: But it is almost—I mean you hear it, you say "Oh, that's heterophony," you see what I mean. You make a translation, it is not an immediate—we don't sense it as you might an imitation, we make the translation.

KW: That's a good point.

Audience #6 (Kamran Ince): Actually, when a lot of Turkish pianists, classical Ottoman music pianists, well, when they played on the piano, they played it that way.

CF: Oh, they played that way—really?

KI: Exactly.

KW: I am very interested in that.

CF: Did you know that?

KW: Yes, I know there were pianists playing that music in Ottoman times, I am also very interested in that—what techniques they used.

Michael Ellison: Okay, so if there are more questions, let's ask them outside.

KW: Please—let's keep up the dialogue. Thank you very, very much for coming.

SOUND ALCHEMY

Ana-Maria Avram

Hello to all! As I was invited to speak with you about my work, I thought to complete my speech with some music examples on compact disc, but I also invited soloist Cornelia Petroiu from the Hyperion Ensemble to exemplify live one of my works. I would like, first of all, to speak about the principal trends that influenced my music, especially about the spectral tendencies recognizable in my work. When, as a young composer, I made the choice of experiment in composition, and I was searching for my own way to evolve, I joined a group, the Hyperion Ensemble, which came to outline itself as bearer of a spectral trend. This particular trend was both original and forerunner, compared to similar European tendencies. It was a unique experimental trend that I perceived from the beginning as being a strong reaction against blocked thought, and which began in Romania as a movement around 1965 or 1968.

Speaking about the spectrum, I first want to emphasize two different aspects which I discovered when I was still a student, and when I made some ethnomusicological research. Making a parallel between Japanese or Indian traditional musics and Romanian folk music, I first became aware that all these archaic musics were using harmonic resonance and the series of harmonics. I was amazed to find a strong connection between these roots and the perspective of innovation, the chance to experiment with new things in sound, today. I secondly discovered that there were two different attitudes when referring to harmonic spectra in traditional music. First is the use of natural harmonics, in a concrete way, using instruments built and conceived to play only this kind of sounds, as the Indian sitar, for example. In Romanian traditional music, we have a huge variety of alpenhorns, specially constructed to play harmonics. The second attitude is quite different, even derived. It came from the awareness of natural resonance, and it consists in the use of scales and modes clearly derived from the series of harmonics. We have, for example, a few modes, very often used in all Romanian folk music, called in musicology the "acoustic modes," which of course are not

only Romanian. But is the result already spectral music? I doubt it! Even these modes come from the first eight harmonics; the result is nearly, but still not spectral music, because in spectral music you would need to have the real octave of the sound, together with a particular color, a non-tempered intonation, with an internal rhythm, and with all these things that make a sound unique, a unique being. It is not an abstract, written sign, but a real and unique sound, which includes a pitch with particular timbre, its own intensity, its own internal *rhythmus*, and so on.

We strongly have to underline the difference between these two attitudes—first, the concrete use of harmonics, and second, the use of scales derived from the harmonic series. As all musical phenomena belong to acoustics, nothing in the sound domain exists apart from the acoustic! Thus, also the major scale belongs to acoustics, being in some way a revelation of these phenomena. But then, why cannot Mozart or traditional music using the "acoustic modes" also be defined as spectral, and where can we detect the essential difference? Using concretely harmonic sounds, and using scales derived from natural resonance are two very different things.

In addition, it is very important to recognize them as being different, because I think there are many composers and trends in Europe that vindicate themselves from a spectral thinking, but use modeling of spectra. Modeling means creating an analogy. Therefore, in those trends, there is a use of these analogical models of real spectra, but instead of harmonics, there are real, and often tempered sounds! In fact, they are an orchestration, an arrangement of a pre-established spectral pattern, made with "real" sounds.

On the contrary, in the Romanian spectral trend, we are using mostly concrete harmonic sounds, multiphonic sounds, only sounds that are spectral sounds. The dramatic problem emerging when using these sounds is the possibility of always reproducing them identically, a *sine qua non* for composition and interpretation in the European approach. Because all these phenomena—multiphonics, beatings, harmonics, and so on—are often very fragile, imponderable sounds, they often need particular conditions to emerge, and you cannot any longer construct the music from the same basis as a music made with the 12 tones of the tempered scale.

To return to my musical beginnings, I will show you now a fragment of a very old piece for prepared piano and electronic tape, composed in the late 1980s. *Zodiaque* for prepared piano and magnetic tape was probably my first work calling for a spectral tendency. Well, you can find here a very primitive form—but also efficient for me—of the use of natural harmonics as a continuum, a whole, an aura, an atmosphere. I wanted to reflect in my

own way the relationship between continuum and "discontinuum," consonance and dissonance, static and dynamic (in fact the static part is the *Moment-Formen*, the piano events that intervene on the slowly turning fund, as on the canopy of heaven). What is here purely spectral—the continuum tape part—is the use of the natural resonance and of the principle of perpetual transformation of sound instead of a combination of sounds, as in structuralist music. The tape is analogically worked; I made it with a very old analogue Moog synthesizer that I still love very much. I think that digital, modern synthesizers are completely uninteresting, directing yourself through a pure musical folklore, through the "public domain" in sound!

But "spectrality" concerns not only the harmonics and inharmonic sounds which are used, and the reference to spectra. It consists in something probably even more important, which makes the essential difference with other musical trends. If it is obvious there is a completely pre-established hierarchy of the sound parameters in a rigid order: pitch, rhythm, intensity, timbre, as you can find in classical or modern music—in all combinatory music—you can play the same music on flute, double bass, or oboe; the timbre is something **added** to the music. (The timbre is, for example in Bach's music, sometimes not even mentioned.) But in spectral music, all that hierarchy became null and void, because all the sound parameters constitute parts of a continuum, of an unshakable whole. The sound is a living being, not a sign which you can transpose anywhere on the five lines of a staff. I see the essence in detail, and thus I build from other motivations. Thus my work, derived from a spectral conception, has a different insistence on the sound, it is based on the very concreteness of the sound.

Now, as I already evoked, the most dramatic problem is how can we construct with these kinds of living beings, with sounds that are individual, which are unique? How can we construct, because we can have timbres, but what will we do with them? Of course, we can analyze them with machines, after that reconstruct them, "modelize" them as in the French spectral school, for example, in order to always reproduce them similarly, and so, legitimately use the traditional, structuralist composition tools we already know very well, instead of searching for others, eventually more appropriate, derived from the sound material itself. On the contrary, you should never conceive of the musical form as something **added** to the sound material. The material itself contains the reasons of its own evolution, of its own form; it generates its own space, its own temporality!

Also, the means of obtaining contrasts—the primary condition for a construction/building in music—are different in spectral music. One of the most important sources of contrast here is the relationship between sound

and noise, for example. I thus apply the principle of the continuous transformation to a non-figurative material, drawn from the acoustic basis of the sound spectrum. So, one of the composing/building tools which I am using with predilection is heterophony. It allows an organization of the musical thought according to closer laws, according to the inner life of the sound. Well, it allows it but does not imply it inevitably, because with heterophony one can just as easily compose structuralist music, serial music, music with textures, or spectral music.

In fact, heterophony represents a point of conciliation and at the same time of specific difference towards all the other sound methods of organization. It approaches homophony by the fact that the voices that precisely just had been dissipated, meet suddenly on unisons. It approaches polyphony by the multiplicity of the networks that can be drawn starting from a single sound, and proliferating. It can be applied to not only the dominating parameters of classical music—pitches and durations—but also, which appears at the same time more attractive and refined to me, to the timbre and dynamics. For spectral music, heterophony represents a manner of ideal organization. It allows all kinds of "jammings" at tiny distances between the voices—sheer delights—inconceivable in a polyphonic manner. It allows then the recall and the rest on the fundamental, the generator of harmonics; it realizes a better pertinence, for the ear, of the relationship between sound and noise, which I formerly evoked. Thus, the composer, while eliminating prejudgments, while refusing already-obtained means and those of his previous experiences, must find the genuine, pure state, wherein he discovers [which is] the direction claimed by the material itself, which is its resistance, even in the least details, and then decides, on each level, [which are] the suitable techniques of working.

For example, I will show you now another spectral music I made at the beginning of the 1990s, which is not using in an obvious way the series of harmonics: *Quatre Études d'ombre* (Four Studies of Shadow) for bass flute. I have here also a score of it.[83] This music is a meditation inside the spectrum, in four different ways, about general sonorous realities like continuum/discontinuum, transformation/identity, sound/noise, internal/external rhythm, etc. It consists of four essays about the relationship between spectrum and playing techniques. The first movement is about beatings; the second about a few different formants which, when emphasized, change the evolution from a harmonic to an inharmonic

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[83] [Instead of examples from this piece, we have appended excerpts from the score to *Axis Mundi*, the recording of which accompanies this volume. **[CD 1:6]**]

spectrum; the third exposes the harmonics simultaneously and spread apart; the last movement is again about noise and beatings, but using a glissando technique. What is the idea of this work? Why is it called *Four Studies of Shadow*? First because of the fact that after an activity, a reaction, a step, you have also the silence, a rest, and I expressed that in my own way in this work: after an active sound, for example, you can have the breathing, the inspiring—its shadow. But there are different shadows too: for example, a key noise can be a shadow of a slap tongue, or a multiphonic can be a shadow of basic sound. When I composed this piece, I was also confronted with a serious problem of notation.

We will now speak about this problem of notation in spectral music— more important than in any other contemporary music trend because of the reference to timbre and how one can write down the timbre, the evolution and transformation in sound, which is something very important and new. How can a transformational thought be scored, as until now we used to score only structuralist thinking? As spectral music refers to a new reality, this reality means that you need also a different reality in scoring. But here you are confronted with a paradoxical contradiction, between accuracy and freedom/indeterminacy—both of which you have to accept, according to the truthfulness of the music.

In fact, in all music there are certain fixed parameters and other mobiles, which take different values each time the music is played; in all music, there exists a rapport between liberty and precision, and differences concern only the particular parameters implied in this rapport. We should not forget that it is only in the European tradition of the last centuries that we find this ambition to note everything on the score. The most significant aspect of music, the essence, we owe to the living, oral traditions. Moreover, in cultures like those of India, Japan, and China—no matter that there was a well-developed notation—there always remained an aspect that was learned only through long oral exercises.

As Western notation falls exactly between the concepts of an acoustical representation and of instruction for performing—of doing a particular action or gesture when performing (which results in a concrete sound)—then the written text can only and at once reveal and betray the work. But what is betrayed and what revealed in the scoring of a spectral music? Because, although transitory phenomena, or elements of noise, were the first elements to be eliminated from the system of notation in combinatory music, that would not be possible any more in a music where the sound reality, its concreteness, constitutes the very essence of the music. Should we give up

notation? Can those problems find their resolution in a "text composition"? Is timbre "scorable" otherwise than tautologically?

We should probably begin modestly with the graphic representation, as precise and pertinent as possible, of the new playing techniques. But even in this single point, there is much unknown. Is it a multiphonic, for example, a different/other reality, or just a heap of diverse sounds? Is the mention (in scoring) of this component pertinent and sufficient for obtaining it? The same question goes for the partial sounds, micro-intervals, etc., which are supposed to be present with a particular color, obtained from a particular fundamental sound, with a particular fingering. So you need to have some technical knowledge about the construction of the instruments, about the fingering, and here there is much ambiguity, because in wind instruments, for example, multiphonics and chords are an effect that you can obtain in different ways, but the construction of instruments, even similar ones, is not identical in the world!

There are also a lot of other fundamental questions to be solved: how, for example, does a new sonic reality—as the evolution, perpetual transformation of an instrumental sound—find its expression in a score? How could one solve, on the same horizontal dimension, the problem of rhythm and the one of perpetual but definite/definable changing of timbre, the progressive adding of noise, or the combination of several playing techniques? Because spectrality means exactly that, taking into consideration all the sound parameters together.

The score is very important, but you also have to apply yourself in a different way, while ensuring the sonic results of those scores. It is necessary to offer to the players a model to follow, both score and sound result at the same time, really to be able to clarify your vision. That is why to make recordings, CDs, is very significant. I cannot leave these things to the goodwill of the musician, considering the music I do. I would like to allow only the score to reveal its truths, but it seems rather difficult, for the moment, because if things are new you have to explain them to have a very good result, and a real/truthful result. Sometimes when you imagine something, you need after that to be confronted with a sonic reality in order to compare it with the hypothesis from the beginning. That has nothing to do with the capacity of imagining sound, of the fact that you cannot imagine very well what you want. But the new things have to be verified. It is simpler to verify them yourself when you work with a computer, for example, when you are doing computer-assisted music. Why is it so important to do that? Because you can enter into the interior of the sound

differently than you can with musicians, more deeply. You can also enrich the spectral reality in that way.

With the beginning of the electro-acoustic work, using the computer as a sophisticated tool with the aim of the expansion of the sonorous field, I realized how different and alive the approach you should have here, where one works directly on material. "Computer-assisted music" means, in my opinion, the transformation of sound sources, of material, with the purpose of obtaining a new one, different, by the use of various programs of sound processing. That always returns to the idea that I seek, of sound alchemy— of perpetual transformation, continuous variation in the sound. It is also one of my dreams to enrich the sonorous reality of spectral music by adding things to the natural acoustic world, and we can do that with the computer.

A quite recent piece for viola and computer-assisted part, played by Cornelia Petroiu, combines the reality of natural spectral music for instrument and pre-recorded computer sounds, resulting, in fact, in a more complex music that involves both realities.[84]

Then for me, by the mixing and fusion of acoustic instruments and electronic, computer-assisted sources, you can obtain the maximum complexity, either regarding the increasing sonorous density, or for obtaining a true alchemy, equivalent in music to the poetic metaphor.

Thank you very much.

RECORDINGS OF WORKS CITED

Quatre Études d'ombre for bass flute; *Assonant 3* for flutes and percussion; *Métaboles* for solo flute; plus works by Iancu Dumitrescu. Co-production, Paris: Artgallery, ESL 009; Bucharest: Edition Modern, ED MN 1007.

Quinconce for viola and computer assisted sounds; *Incantatio* for viola, percussion, and large orchestra; plus works by Iancu Dumitrescu. 2003. Bucharest: Edition Modern, ED MN 1018.

Zodiaque for two prepared pianos and electronic tape; *Ekagrâtâ* for orchestra; *Signum Gemini* for clarinet, prepared piano and two percussion groups; plus works by Iancu Dumitrescu. Bucharest: Edition Modern, ED MN 1002.

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[84] [Cornelia Petroiu then gave the world premiere performance of *Quinconce (III)* for viola and computer-assisted tape.]
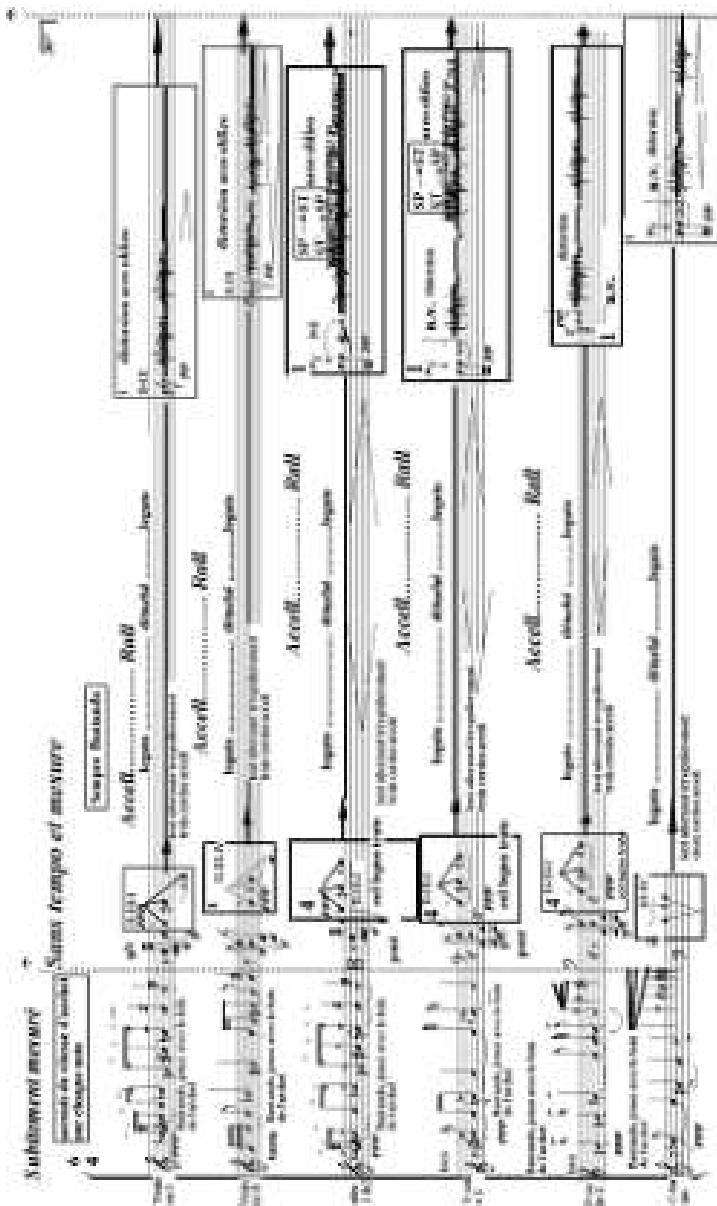
Example 1a. Ana-Maria Avram, *Axis Mundi* (1998-2004), page 5.
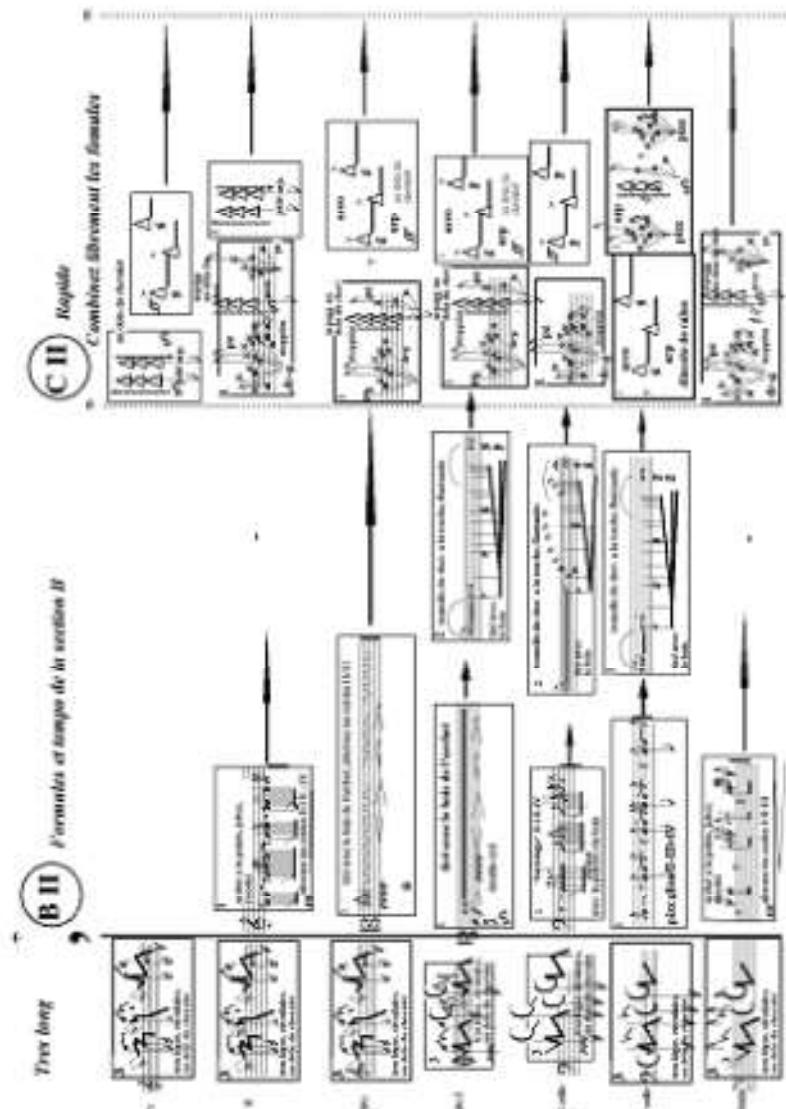
Example 1b. Ana-Maria Avram, *Axis Mundi* (1998-2004), page 9.

214

POETRY, PAINTING, HISTORY, AND CONSCIOUSNESS

Xavier Dayer

It may be interesting to say a few words on *To the Sea*, because it can give an example of my way of working with timbral considerations, even if I must say at the beginning, since we are in a spectral conference, that I do not feel myself to be a spectral composer. It is something important in my music because I studied for one year with Tristan Murail in IRCAM (Institut de Recherche et Coordination Acoustique/Musique), and his music is an influence, I would say, in my world. I do not use straight spectral techniques, though, so you will not have the same kind of explanation as before, with very technical procedures.

To the Sea is a piece for alto flute solo, which I wrote around five years ago, in 1999, at the same time as a more important project: in this period, I also wrote a chamber opera, *Le Marin*, for three singers and ensemble. Like often when a composer works on important and large works, the shorter and the more subtle pieces are, I would say, in the same fluxes or in the same movement as this opera. Therefore, I have to say just a little word on this opera, to give you maybe the context of this issue here.

Le Marin is on a text of a very famous Portuguese poet, Fernando Pessoa, who has been very important in my work since that moment, since 1999. For me, what is important in his poetic work is that it is a work on identity. The question of identity is very interesting for me in a musical sense because, and there we will maybe join the timbral aspect, because what fascinates me in music is the ambiguity you can have between two sounds, between two moments of music. This kind of in-between moment, where the listener does not really know whether he is hearing a flute or a cello—a traditional thing that we have had since the end of the 19th century—is for me still very important. In this opera, the three singers were each doubled by one solo instrument: a clarinet, a cello, and a saxophone. It was like a sort of Bach cantata aesthetic: I mean, each time one of the soloists came, the double came too, like a sort of color, a sort of atmosphere.

In *To the Sea,* you have the same preoccupation, to create with the flute, in my idea, with the techniques of traditional and 20th-century music, but to try to create a conscience, a feeling, where the start of the material is difficult for the listener really to fix. Here you can maybe approach it to a spectral way of thinking about time, because one of the ideas that are very strong is between these different moments that make a process. What is interesting and the opposite of some tonal procedures, is that you do not really know when it happened, and suddenly you are in a second state of conscience, or state of music, and say, "oh, we've changed," and this is for me very important.

We need to go a bit farther with this piece. It is an homage to the painter Cy Twombly, an extra-musical influence, which is very often the case when I write. I do not think that there is a strict analogy to be found; it is more a way to give ideas, to be like in a context where something else can bring musical ideas. That is a personal thing. What is interesting for me in Cy Twombly's work is that you have always a very wide surface, very clear with almost nothing except sudden inscriptions, which are words, or a kind of drawings, like child drawings with a very, very clear, not dark color. You never know when the word is going to appear, or when it is just something like color. What is made interesting for me is a reflection, thinking about timbre, because often we think timbre is like color. This is something that in a certain way or analogy means that we do not give to the timbre a meaning sense, it is something that is only given to color, something else. In the case of Twombly, you have suddenly the ambiguity, the same ambiguity that I was talking about before, that is going between the moment when something is a meaning, and something is only a visual use. I am trying in my music, in my way, with a kind of research—this is really maybe the center—to create a moment when the color can be meaning and the meaning can be color.

This morning Tristan Murail talked about the fact that for him there was no meaning in music. For me, it is not that music means something in the same sense as words, but we have a meaning that is linked to our history of music. Because each time you play something, if you play a fourth, if you play a second, if you play any interval, if you put it for an instrument, you come with a whole amount of reference. This can change for a listener, but for the composer it has all the amount of different references. Like in poetry, when you say "the sea," it is thousands of different evocations. I like to think of music in this way. Of course, it is a very personal act, a very introspective act. Each time I put a note on the paper I try to think about the consequence of the reference and of the analogies that I can make, through

my knowledge of the history of music, into the past. I am more of the feeling that today we have to deal with the past. We cannot do as if we are in front of history like something that is in the present. In this sense, the meaning of the musical sentence starts at the moment when for me it starts to be connotative, to something known, something that you can name. You find this idea of name or word, something that you can say, "Oh, this is like Debussy," "this is like …," and you start to give a sense and a meaning. I try to work with a consciousness of that, meaning that each time I personally feel this connotation I try to stop, or to put this beginning of a sentence in a kind of in-between situation. That explains this reference to Cy Twombly, and I think there is an analogy in this kind of thinking in painting, in his way.

To illustrate this, I am often thinking of a sentence of the painter [Henri] Matisse, who said that color is not surface, but flesh. I like the idea that at a certain moment the choice you make of an instrument, the choice you make of a timbre, is not only something that will give the surface, but is really inside the composition. In that way, I never write a note, I never write a pitch, like many composers, without thinking of when it comes, who is playing it, and what its density is in a timbral sense, which is not at all like the way of thinking in the serialism aesthetic.

One can hear a completely different aspect of my music in which you will find some kind of links. I just wrote a piece for the Stuttgart Süd West Rundfunk Vokalensemble, a professional 36-voice ensemble that is really fantastic. You have here the opportunity to work with three different choirs of 12 voices, each of them solo, and in different spaces. In the recording, you cannot have this really in your hearing perspective, but I had this kind of reference also; you find this same idea of reference to ancient music, double choir, and so on. It was really conscious. I tried, in this piece, to work on several different languages. You find some Portuguese, always with this Fernando Pessoa, which comes like a kind of shadow in my music, but also English, also German—a kind of Babelian world with many different languages, which is again this search to put the human listener in this in-between situation: in-between sense, in-between languages. Maybe this comes from the fact of being a Swiss composer, of being in a country that is in-between. I am from the French-speaking part of Switzerland, and we have a great deal of French culture, which is very important for us in reading and literature, and in how we learn. The majority of our country, however, is more influenced by German culture. You find this also in music: if you think of the major Swiss composers now living, like Heinz Holliger or Klaus Huber, they are more, I would say, German aesthetically, and you find a

completely other way to approach timbre and to approach meaning in their music. Maybe for me it is important not to choose, I would say, but to live in the intensity of being in-between, and feeling all these different tensions around me. You may find a little bit in this piece, this kind of preoccupation.

The piece I just wrote in this year is called *Soon Dispersed*. "Dispersed by the Wind" is a sentence of Kleist, the German poet, which is quoted in the text. Of course, I do not have to explain that the multiplicity of identities of the Portuguese poet and the different voices and the different choirs, tries to give a question on unity, which is not possible. That piece gives a different aspect of my music because of the amount of the singers, and also it is very different from a solo piece.

On the question of material that I use for composing, how do I come to these different harmonies and this different time? I have great difficulty to think of what I call non-time in music. It means all that can be abstract from the time direction, like a simple amount of notes, which would be like in spectral music, or like in many different ways of thinking, the points where you have to go. Even though I have great admiration for people who have very strong abstract schema in their music, for me it is impossible, because it goes against something that is feeding my musical desire: to be a kind of imitation or analogy to what is happening in our consciousness when we are just walking, for example. I like the idea of walking without any aim. It is very important for me to express what can happen in a human mind when you just do an action, when you do not have a goal, you do not have a place where you have to go. It is sometimes a way of working that can give something that is not standardized, that you do not know where you are going. In this piece, for the first time, I worked without going from the beginning to the end as I did in other pieces, but instead I went in a kind of mosaic way of composing. Just writing in detail I completely finished a part, and another part: I know that is going to be at this moment, then another part. It is always identical to one another but with differences of languages, of harmony, and it is after what I do—the blanks between all these different parts, which had been written in the beginning—that I start to feel the spontaneity I am searching for. To do a little résumé of this, there are two major things for me: the historical analogy you can always make when you are hearing music, like a poetical thing that is always present and you cannot imagine the sound without having the whole history with it. The second point is, to try to have a musical form, which would be like what is happening in a moment when you do not really know what is happening, out

of the control of consciousness. That is maybe what I can say in a few words.

DISCUSSION

Audience #1: Are structural markers not important to you?

Xavier Dayer: They're important, but in the second time, after I'm writing. That's why I have a lot of auto-criticisms. When I write a piece, it's very important for me to feel after, if it works, if the markers work. But it's just impossible for me to put them, that's why I'm saying out of time, like things that are out of the musical feeling of the time; I can't do it. So they're important, but as a way of going back to the score, to the sound. I'll answer it that way.

Audience #2 (Michael Ellison): I find it really fascinating the way you're relating … you're in the position of a lot of young composers today, you know about spectral music and you're influenced by it, I'm sure in some way, but you don't necessarily choose to use that language, sometimes perhaps not at all. With your first piece, I thought of the French composer [Philippe] Hurel, and how he said we want to reintegrate repetition and motive. For some of us we never let go of those to begin with, so to read these words is surprising if you're not from a very French culture in music. I just find it fascinating, and I wonder whether you'd comment on what you took from Murail in your study with him that you feel is of value to you.

XD: I have one souvenir, one memory of something that was kind of the [?] moment, when he talked about the analysis—I don't remember the piece for which he did that—but he did the analysis of a sea wave, very precise, with all the numbers. I found that so great. The idea is finally for me very romantic, because it's the idea that in nature you have somewhere a kind of model that is maybe in a kind of philosophical way the right model. In that sense this very, I would say, scientific way of thinking of spectral music was completely poetic for me, because the model was lots of numbers, but he was just going freely. To make music he had to go like a composer with all his intuition into these numbers, but with the conviction that they were surely better than other numbers because he found them in nature. For me it's something very important he gave me at that moment, without maybe knowing he was doing that. I like the idea, and it's very intense to me, that you may be rather in the right way of working if you're looking to things that are existing, if you're taking nature or you're taking, maybe also cities, I

don't know, but real things as a model, but after you can't do a straight analogy to them.

In the sounds of words (for me language is very important) and the rhythms you have in a language I can't understand (I love languages I don't speak), you find this. Sometimes I note the rhythms of, for instance, every fricative, every sound—very percussive. In my way, I try to use this rhythm as a canvas for a piece, so it's a little bit the same thing. It's the difference between what is language and what is speaking, *entre langue e parole*. Because speaking, *parole* in French, is something that nobody decided at any moment. It's common; it came with time. I think that new music has to go to the *parole* now, to go away from the creation of the language, which was important at a certain moment, but now we have to find something that is more integrated to—maybe it's a romantic word—but to something that is natural, something that comes from a model. For me, he was doing that without saying it. But why to choose this kind of noisy sound which was a wave, is for me a mystery.

THE IRRADIANT FORCE OF SOUND

Iancu Dumitrescu

Concerning my work, what can I say, very rapidly?[85] Generally, I refuse to speak about my music, basically because I need too much time to explain, to résumé anything that would clarify even a small detail, and because music in my conception—even if inevitably made with sounds—is at the same time something irrational, which transcends the small reality of the sound. The acoustic space is very small compared with the infinite space of musical creation. It seems complicated for me to describe this long artistic adventure through spectralism, so I will try to present my work as briefly as possible, providing the information I guess you are looking for. I will also give you some examples: some fragments of several works belonging to different periods of creation, some on CD and some live, in world-premiere performances.

First of all, I must say that three different periods can be distinguished in my work. The first is the one with a spectacular entrance in the ideas—then very new and almost unknown all over the world—when the incipient spectral trend was prepared. The second one, in my opinion, should be the period of maximal development of the spectral evolution. From this period, I would mention the series of works entitled *Movemur* (at the beginning of the 1970s), *Movemur et Sumus* (1978), the *Medium* series (1972-79), *Cogito - trompe l'oeil* (1980), *Sound Sculpture I-II*, etc., which were for me among my most important works of that period. Starting around 1990, there was a dramatic change in the evolution of my musical language, due to the use of the computer in producing sound. In a way, I would say I did not abandon the adventure with acoustic instruments, but I moved the center of my interest in experiment from instruments to the domain of computer sound, at least in its very experimental side. I extended the field of sonic adventure,

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[85] [Ana-Maria Avram prepared the present text from Iancu Dumitrescu's statements given at the Conference.]

the forthcoming discoveries in the field of computer-assisted sound, as shown by the works I composed in the last five to seven years. My investigations are of a dramatic—I could even say tragic—philosophical speculation on the inside of the sound.

Let us, however, go back to the beginning, the first period of creation, and speak about the things that most influenced me, and about the ideas that guided me. Between the mid-1960s and the decade that followed, after a very difficult, closed, Stalinist period, the cultural life in Romania became little by little more open, through modern ideas and initiatives. Concerning my work, after a first combinatory/structuralist period—while still a student I composed my first pieces, influenced by the discovery of dodecaphonicism, integral serialism, and so on, which where the leading ideas at the worldwide level—my conception soon moved through a more transformational musical thinking.

From the beginning of the 1960s, I discovered the irradiant force of sound. The study of traditional Romanian folk music was for me of first importance, because in this very rich and diversified music I discovered something really new and fresh, and at the same time very old and ancestral, but also a particular and different musical attitude, an unknown musical world, another approach to acoustical phenomena. For example, the natural harmonics, as reflected in the music for alpenhorn, or for two or three alpenhorns in a polyphonic relationship, with an incredible richness in its harmonic space, formed my earliest experiences of the spectral dimension of the acoustic world. I first discovered the irradiant force of the fundamental sound, and the transformational principle in music, as opposed to the structuralist/constructivist principle. Music opposed to structuralism does not mean music without structure; on the contrary, it is a music that from the first contact seems very structured, but just differently, more secret, not yet evident, with very fine, refined details, and with a polyphonic dimension also.

My situation was very different from that of other composers. In the 1960s, when I was a young composer, my teachers were very strongly engaged in a modernist trend in Romania. In fact, they were applying discoveries that were already evident, made by the courageous leading figures of Western music that they admired, approved, and imitated with small personal contributions. After a few years, after this contact with folk music, as just mentioned, I meditated on this very simple idea: that it is necessary to discover my own way, my own direction, as I did not think it was of any importance to do the same things that others were doing. I tried to discover what could be done, what was acceptable for me, what was truly

profound and original. I was searching for an alternative to this exceedingly "written" music, the one preached by my teachers, adepts of a structuralist modern musical thought. Little by little, I discovered freedom in music—my own freedom. This was going together with the discovery of the importance of being, at the same time, not only composer, writer of musical signs, but also interpreter, player. I was a piano player, and a little bit later, I began to play other instruments too.   After this, I discovered the solution of conducting and it was the beginning of my ensemble, Hyperion (very famous today); and so, working with Hyperion, I built my own laboratory of musical thinking.

Then I discovered and contacted the great conductor Sergiu Celibidache, one of the greatest thinkers in conducting, perhaps one of the greatest thinkers in music, of all time. He explained to me the perspective of phenomenological thinking in music. Evidently, music is nothing. Music is irrational; it is impossible to conserve music. Music is a way, if you accept as in mysticism, through transcendence. The score, the paper is not the music. This was the idea that most strongly impressed me, a strong attack against usual musical thinking, and it was the beginning of a new, truthful perspective for me. Then, music does not exist. It is a perpetual becoming, nothing fixed. After years, when little by little I was more and more able to follow Celibidache's way of thinking in music, and to apply it in my own, personal way, I developed a truthful phenomenological composition—not interpretation, composition—which became the basis of my musical thinking. It means to assume the acoustic, to assume all the conditions of the birth of the music, the whole, the quality of the players and the instruments, to exploit at maximum all the concrete qualities of the material, of the sound. Today it seems that my master, Celibidache, becomes forgotten little by little. What is on the way to becoming lost is something essential for spiritual meditation, not only for music. The act of thinking does not exist as something—it is just a trajectory, something in evolution, a perpetual becoming—and music too.   Music is born, it develops, and then dies. Infinite births, developments, and deaths: only that adventure matters.

Coming back to the works of my first period of evolution, one of the emblematic works belonging to this creative stage of my musical development, when I progressively moved away from structuralist musical thinking, is called *Apogeum*, a piece for large orchestra. I composed it in 1971-72 (premiered in 1973), a piece that is a concentration of spectral energy, force, and spirit. Even though the work is still made with real sounds, I mean with fundamental sound, not with harmonic sounds, multisounds, or overtones, it is an obvious attitude towards sound that

transgresses the appearance of the sound, searching through its inner being. It is a meditation through sound, in a huge mono-structure. Here is one of the first times I tried to concentrate my musical thought through the meditation on the sound, which evolves in successive strata from a unique sound to a cluster, a totality of sounds. The cluster here does not have the significance of the whole result of a combinatory, but the conquest of an acoustic space. The work is meditative, concentrated, non-evolving, and slowly transformational. In the middle of the piece, the climax, there is an important percussion section strongly contrasting with the general evolution of the work, a sonic and rhythmic explosion that crowns and at the same time contrasts with the mono-structural evolution of the entire work. This piece, I think, illustrates the better this point of my musical evolution, where elements of constructivism/structuralism, still somehow present, appear together with new ideas connected to a primitive approach to a spectral sonic world.

It became more and more clear for me that my music should not be a combination of sounds, not a construction with sounds, nor a combinatory similar to the dodecaphonic (serial) technique. The central idea of my search then became the way of discovering **the intimate power of transformation in sound, the evolution of the spectral sound matter in time** (the transformation of the sound, the transformation of the spectrum). According to that, I generally refuse repetitions, in the classical way; I refuse variations, the classical developments, the classical contrasts between textures and structures.

I will now try to discuss a few of my most important works of this second period, which often are grouped in more general series or classes of composition following a particular musical idea and principle, such as the *Movemur* series and the *Medium* series. *Movemur* is a paradigm of many compositions, a series of works, a family developing the same musical ideas, which I began in 1972-73, and is still in progress (I plan to complete this series with new works), dedicated to string instruments or string ensembles, going from solo to string quartet and orchestra. The central, cardinal compositional concern is connected to natural and artificial harmonics and spectrum. It was a pioneering period, compared to what happened in these years, the early 1970s, at the international scale. Now, I realize something very interesting: that spectralism appears in music in a sort of synchronic way, even with the inherent decay specific to music, but still synchronically, with other similar research in spirit; Bertrand Russell said somewhere that the most amazing thing in modern science is its return to Pythagorism!

Concerning *Movemur*: on each free string of the instrument, considered as a fundamental sound, are built up clusters of artificial harmonics, strictly enough deduced from the mathematical theory of crowds, and respecting the symbolic and expressive value of number. The work requires a particular skill of the bow, which constantly changes its position in relation to the bridge, in the goal of a permanent transformational sound, and harmonic spectrum. Harmonic sounds are produced also by a constant change of finger pressure of the left hand. Vertically, the music is based on heterophony: voices disseminate, spreading in swarms of harmonics, then assemble in unisons—the free strings themselves.

In this period, I extended my musical experiences with the Hyperion ensemble to some of the greatest soloists dedicated to contemporary music, to the research in modern music, such as the unique double bass player Fernando Grillo, and so I could develop my strongest musical ideas of this second period of my work. The virtuosity, skills, and dedication of musicians such as Grillo and others made this evolution in sonic adventure possible for me.

In addition, in this second period, my music notation changed, evolved a lot, in connection with the research in the spectral sonic world and phenomenological musical development. Particularly in this period, my scores acquired a very unusual, accentuated graphic aspect, superposed to the indications of pitch, rhythm, and so on, as I felt the need to see the music as well as listen to and hear it. It was important to see it in order to feel the configuration of the music, the evolution in densities, and the gravitation of the lines of force. I am convinced that music evolves, or should evolve, more and more decisively, from combinatory thinking through transformational. In my particular case, the transformational principle is omnipresent, I think. A sound is a being that is born, develops, and dies, while perpetually transforming all of its components. So the problem of writing, of notation, became infinitely more complex, as you seem to be obliged to write down the imponderable.[86]

In the *Medium* series, there is more than simply the spectral idea; it has another specific reference to my musical thinking: acousmatics. Along with the spectral and phenomenological ideas, and in consonance with both, my music is based on an **acousmatic aesthetics** by virtue of which the sound is subjected to analyses and dissociations (harmonic multisounds, natural

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[86] [At this point in the presentation, Cornelia Petroiu performed the world premiere of *Movemur X* for viola (1978). This was followed by the world premiere of *Medium XII* for double bass (1980), performed by Ion Ghiță.]

harmonics, artificial harmonics, diagonal sounds, and distorted sounds) which confer on it a genuine and primitive force. For other modern schools of composition, especially in electronic music, acousmatics means just the physical disguise of the sound—you cannot see the source of the sound. For me, however, of most importance is the metaphoric idea of this disguise: the fact that, whether you can or cannot see the sound source, you cannot and should not analyze it; it is a sort of alchemy that transfigures the sound, so you cannot recognize it anymore. To arrive at that result, as I have already said, I searched for and discovered new techniques, diagonal techniques; I developed new practices for string instruments and "invented" new sounds, also for woodwind instruments. For example, I developed the prepared bassoon in my work *La Grande Ourse* for two prepared bassoons, strings, prepared piano, percussion, and electronic tape, which was first performed in 1982 and broadcast by Radio France. My research on brass instruments resulted in the prepared trombone, with many funnels and handmade mutes, and another series of compositions, *Nimbus Solaris* (*Nimbus I-III* on the Generations Unlimited LP). In every case, I develop the use of truly spectral sounds: partial sounds, multiphonics, harmonic sounds, or overtones.

Coming back to *Medium*, referring to the very concreteness of the instrumental gestures, here there is also a phenomenological principle of feedback, a perpetual response to a primary stimulus of reaching for the limits of the possibilities of the instrument. It is a total adventure, where the player provokes his instrument, reacts consequently to the result, and so on. It is a simultaneous provocation of the instrument, the acoustics, and the spirit. The player finds himself in a transcendental state by concentrating for long periods of time on a unique sound generated by the free strings of the instrument. Various bowing techniques force the free strings to obtain most intriguing and electronic-like sound effects.

You would probably think there is a large amount of freedom, here, but it is just an appearance! Some can even imagine that it is a sort of improvisation, in the most trivial sense of the term. In fact, just the contrary, the player is chained to the inner physical laws of his instrument—completely obliged, step by step, and in each instant! His itinerary is absolutely obliged; any freedom would not be possible.

As we arrived with our discussion at this very point, I will now ask Ioan Marius Lăcraru to play for you another important piece I made in this period, *Holzwege* for solo viola. Because *Holzwege*, a German word and a title inspired by one of Martin Heidegger's last works, means exactly that: an obliged itinerary, a way through the unknown—here in my piece through the interior of the sound. Moreover, I will show you how in this itinerary there

is no freedom, once you are engaged in it![87]   Referring to what possibly seemed free or improvised in this music, if Marius played it again, a second time, you would see that even in tiny details he does it the same!

Here, in these fully spectral works, music comes from the intrinsic reality of the sound, as from its basic, essential phenomenon. The sound, however, is not the final reality of the music; as I said, sound is not yet music! The sound is here subject to analysis, dispersion, and spectral dissection. So we can find in its inner body an almost infinite world. Composing with sound spectra, natural harmonics, and other components requires a completely different point of view on the musical material, on the sonic matter. Sound is contemplated, heard with a very fine and great attention, in a sort of magical adulation, and obstinately repeated in particularly long values (and here we should emphasize the fact that spectral music needs and supposes a different apprehension of the time dimension). Then the ear becomes able to discern this inner world of natural harmonics, the interior of the spectrum.

We should conclude this discussion with some words about my actual work.   The third period is characterized by a total adventure inside computer-assisted sound, where the acoustic space is pushed to the limits, to the last sigh. The discovery of the quasi-unlimited possibilities offered by the utilization of the computer in the world of the creation and transformation of sound was for me a new era, of a total engagement, through a hyper- and post-spectralism.

I discovered and appropriated for myself a "cosmic" poetic zone, a "stellar dream"—intuitions that are for me essentials for the imagination of the artist of today. In its essence, this music—whether only for computer sounds or mixed with instruments—is, or at least I intended it so, as genuine as the map of outer space, which is at the same time abstract. I imagined as yet unheard sounds and produced them by means of special computer programs, as a cosmic reflection in which computer sounds are mixed with natural sources of transfigured acoustic sounds.

The work of this new period is a result of meticulous studies in the sonic domain of micro-intervals, and both harmonic and inharmonic spectra **[CD 1:7]**. The essential difference is, though, the discovery and the work with a new sonic dimension (and that in a consequent way), the distortion. When timbre, pure sound, by itself becomes the prime matter of musical speech, to advance and build up the music you need other formal principles, other means of contrast. Because contrast is one of the primordial principles that make possible a musical construction, you need different means to build up

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[87] [Marius Lăcraru performed *Holzwege* (1987).]

the music than in figurative music. I worked a lot on the opposition of harmonic sound to noise (inharmonic sound, distorted sound, etc.). Therefore, you can discover, beyond this constitutive principle of opposition between pure harmonic spectra and inharmonic ones (noises, distortions, etc.), a poetic level, the expanding-beyond-its-limits of the sonic universe, which often in these later works seems to be destroyed or burned, in huge explosions of sonic matter, after which comes a new birth.

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MEMORY AND PROCESS

Joshua Fineberg

For today's talk, I will focus on just a couple of pieces and give a little bit of an insight into how they work. I am going to frame this presentation in terms of the way I see my compositional process developing from one work to the next, and I realize that this is a sort of retroactive teleology made possible only by hindsight. However, going back and trying to make a coherent "developmental narrative" out of the life events and compositional decisions that probably were due to many circumstances great and small—and were not necessarily the output of an intentionally directional process—is a natural part of what we do as composers. Composers take material and make it into form, or we take form and fill it with material, depending on our approach, but we constantly rewrite the past. When I look at my past, I see it as a kind of punctuated evolution; I had periods in which I had specific sets of things I was trying to do, problems I was trying to solve, and worlds I was trying to create. After a certain period of time developing the means to realize these worlds, I inevitably start to feel that I have reached a crisis. By achieving the compositional goal towards which I have been working, I have left myself without a natural destination for the next piece. I have noticed that when confronted with this situation, I tend to set myself structural limitations that force me to stop using the procedures that have become too comfortable, and to reinvent many aspects of my language in such a way as to launch myself in a new direction.

The first piece I am going to talk about is a work from 1994 called *Streamlines*, which represents the culmination of the first phase of my composing. This piece and its fraternal twin *Empreintes* (1995), the big piece with electronics I wrote for IRCAM (Institut de Recherche et Coordination Acoustique/Musique), were the first pieces in which a lot of my longstanding concerns with fusion and finding tools for creating harmonic progression finally came to fruition. Before talking about the problems or limitations that I found with that approach, I want to discus the piece. I first started thinking about *Streamlines* in 1992, a time when many

people were thinking about chaos and complexity theory. My fascination with these ideas was in no way unusual. There was a book by James Gleick called *Chaos*, which everyone was reading at this time. There were unbelievable numbers of pieces supposedly based on chaos performed on nearly every new music concert; most of them would take one of those equations that makes a pretty picture as a screen-saver, and instead of producing X and Y coordinates they would produce pitches, durations, and other musical parameters. The music sounded chaotic, but it did not suggest the emergent order that many of these "chaotic" images "reveal." The power of those chaotic images is not their chaotic unpredictability; it is the fact that, though they are locally chaotic, globally they are highly and simply structured.

I started thinking a lot about what it was that made that notion of emergent order so attractive, and what might be its musical equivalent—this gets back to that Grisey quote I mentioned in my keynote address.[88] Basing your music on sound does not mean a composer should abstain from using extra-musical models; however, it does mean that when you decide to use an extra-musical model, you must find an acoustical and/or musical analogue to that model, so that the model becomes the template for a sonic/musical idea. This will almost certainly require something other than a direct, naïve mapping of a mathematical formulation onto a set of musical parameters. The models may furnish a sort of poetic inspiration, but the ultimate composition will make sense or not sonically.

As I thought about the various mathematical functions one encounters in these books about chaos, I came to a few conclusions. These were my own generalizations about the way chaotic functions work. There seemed to be the following commonalities between the many very different systems. First of all, almost all of the chaotic functions you see in those pretty pictures are very simple. They are often oscillatory functions, which give one of two values as an output under normal circumstances; or they are linear or exponential growth equations, which give very predictable output under normal circumstances. To provoke the chaotic results, the equations are given input values they were never meant to have. For example, you take an equation that can only be solved for values between zero and one, and give it a value such as 0.000001; this value is so close to zero that the equation

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[88] See "What's in a Name?" infra. "We are musicians and our model is sound not literature, sound not mathematics, sound not theatre, plastic arts, quantum theory, geology, astrology, or acupuncture" (Grisey 1984: 22, as quoted in Wilson 1989).

stops working in a certain sense, and in that lack of normal function it starts producing unpredictable values. This occurs again and again in chaotic systems: a generally simple, predictable system is pushed beyond its normal boundaries, producing complex results. In and of itself, though, this is just a curiosity—an equation breaks down near its boundary. However, with the proper perspective this breakdown starts to look like something of real interest. This is the other generality of chaotic systems: to find the emergent order you must find the right perspective from which to view the system's output. In fact, one might argue that for many of those chaotic pictures the order is not necessarily emergent in the function itself; rather, the order may well be an artifact of the perspective we find to look at it. When you see those pictures in a book on complexity, it is natural to imagine that they result from mapping an equation that gives you X and Y values like you had in math class, but that is not true. Many of those are one-dimensional equations, so they output successive single-dimensional values. The graphs in two or three dimensions (the third dimension is sometimes mapped to color) you see as a picture might be produced by graphing, for example, the current value against the sum of the two previous values or the current value against the previous value (which might sometimes make sense in an iterative equation, but is used in other contexts as well). In any case, these are very strange ways to graph a function. You would not normally graph a one-dimensional function like this at all, you would be much more likely to graph input against output or output against rank, etc., but that is the kind of thing done routinely to produce these images. One class of strange attractor, that makes those familiar pictures that look a bit like owl eyes, is actually produced with a four-dimensional equation. A two-dimensional slice of this four-dimensional, unrepresentable space is taken with a technique called a Poincaré section. You cannot just take any Poincaré section either, there is one specific kind of Poincaré section, not one specific section but one sub-set of sections, that will show you those little owl eyes. If you slice it any place else it just looks like chaos. Therefore, one could really argue that a lot of what you are doing is imposing order by finding a perspective in which to view the order that is bound to happen accidentally in even a fully random system. We all know that if we flip a coin enough times we will eventually flip heads 50 times in a row; if that is the only part of the output shown, it might seem that the results are very highly structured, almost as if the coin were rigged (but this conclusion will be reached only if by ignoring the 50 trillion throws it took to get those 50 heads in a row).

That notion seemed very musical to me: often, as composers, when we deal with complex material we impose similar sorts of order that may or may

not be intrinsic to the material. So I started looking for a musical system that would work in a similar way, because it seemed like a promising way of capturing some of the essence of what appealed to me in the visual chaotic systems. Through an analogy with the oscillatory systems, I turned to the notion of vibrato. When an instrumentalist performs a vibrato on a double bass with very variable speed and depth, and a low pitch (especially on the lowest string), the upper part of the harmonic spectrum tends to be perceptually distinct from the rest of the spectrum. It stops sounding like a single complex sound and listeners start becoming acutely aware of the upper partials. I asked a bass player I knew to tune his double bass down a quarter-tone from E to E quarter-flat so that there would be no sympathetic resonance with the other strings, and then play an E quarter-sharp (essentially a fingered F), with rapidly varying bow pressure, vibrato pitch, width, and speed, and I recorded this. At the time we did not have nice visual programs like we do now, so to analyze these sounds I could not just get a sonogram, I had to generate a set of more than a thousand text files. Each file was really just a list of frequencies, amplitudes, and phases (which I didn't care about, but which the program gave me anyhow), capturing a snapshot of one moment in time of the sound. You could think of these files as a series of freeze-frame sonic images. I found the parts of the recording that interested me most and started by looking at the analyses that corresponded to that part of the sound. However, I wasn't really interested in the totality of these snapshots, I was only really looking at a particular region of frequencies. I wanted to find the perspective from which to view these frozen moments of sound. I focused on a particular region of the harmonic spectrum, quite far away from the fundamental. In **[Example 1]**, you can see the fundamentals on the bottom (they sound two octaves lower than written), and a band of frequencies quite far from those fundamentals. First of all, because the double bass is a wooden instrument, the spectrum is not perfectly harmonic. Almost any instrument either has a dampening or a spring effect. With the piano, for example, tuners stretch the octaves by progressively greater amounts as they move towards the higher register, because the metal soundboard acts like a spring, adding energy to the vibrating strings, thus making the spectrum stretch a little bit and the partials drift progressively further apart than they ought to be. With a wooden instrument the opposite thing happens: it acts like a dampener, stealing a little bit of energy from the vibrations. The acoustic effect of dampening the vibrations is to progressively reduce the distance between partials. In addition to this inherent inharmonicity, the bow pressure, how tight the string is—because you are really pushing down on the string—affects the

233

magnitude of the dampening. So the playing mode I asked the bassist to use not only altered the fundamental, it also affected the internal structure of the
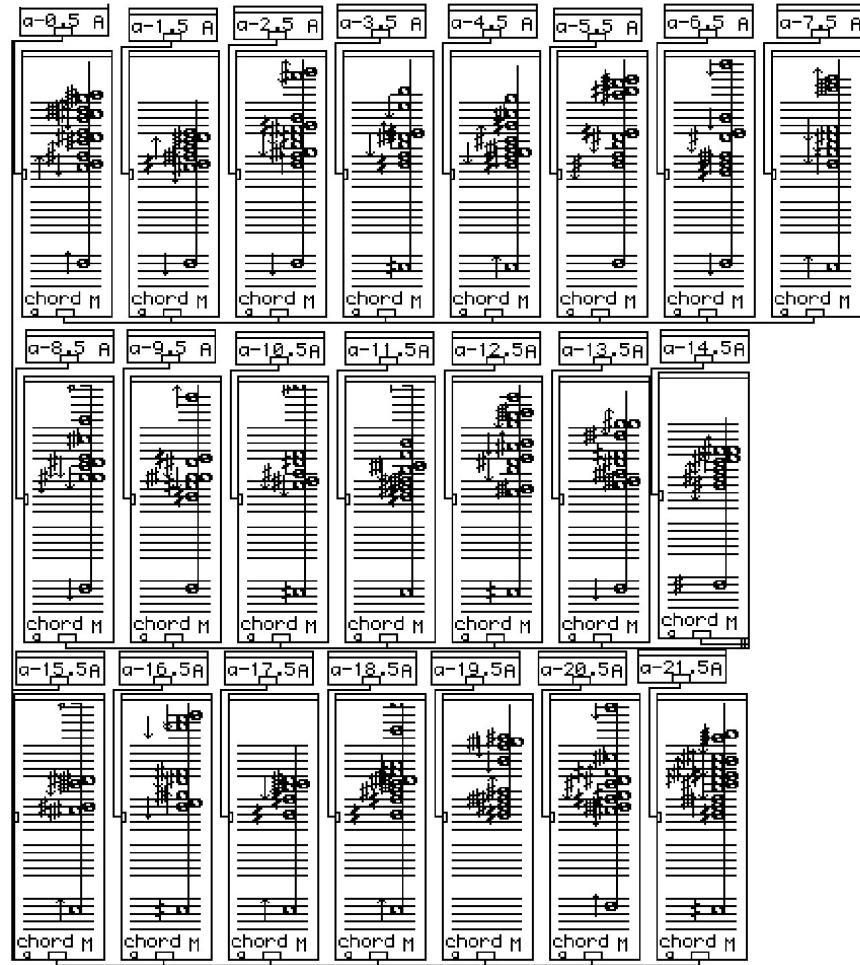
Example 1. Analyses of Discrete Moments in the Double Bass Sound, Showing the Fundamental and Selection of High Partials. The bottom stave in each chord box is in bass clef sounding two octaves lower, the next is in bass clef *loco*, then treble clef, and finally treble clef sounding two octaves higher.

spectrum. What you end up getting if you look at an assortment of moments in this process is a constellation of chords that make a chaotic halo of sound around the attractor of the bass's normal harmonic series built on that note.

My next step was to select a specific set of those snapshots and filter the analyses, leaving behind a small set of notes in a tightly defined register that could be played as chords. **[Example 2]** illustrates a few of these chords before I had done any work with them; the partials of the analysis have been filtered to leave only those with sufficient amplitude and within the desired frequency band or region. I then played back those aggregates with equal amplitudes, as if they were harmonic aggregates. The immediate impression these chords produced in me was the feeling that I had found a set of chords that all seemed related to each other in some clearly audible manner. However, it seemed to me that it would have been impossible to predict what chords could belong to this set or what characteristics defined the membership, or what additional chords might sound as if they belonged. My goal had been to create an auditory equivalent to the notion of a strange attractor and this sensation—that these chords shared some difficult-to-define but easy-to-hear commonality—seemed like a very closely related impression.
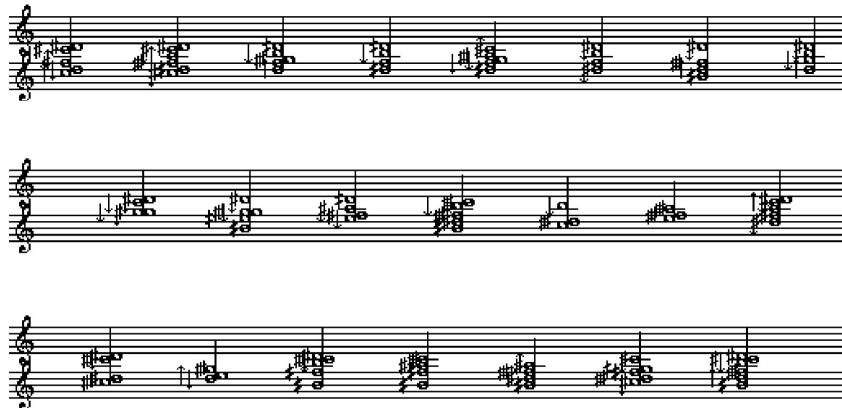
Example 2. Chords Created by Removing Partials which Are Too Weak or Outside of the Desired Frequency Range. Notes in the upper stave of each system sound two octaves higher than written.

235

At this stage in the composition, I already felt as if the basic premise was possible to achieve: I had chords that really felt like they had some sort of relation but still clearly possessed that chaotic unpredictability where it was impossible to say what specific relationship one had to the next, even as you perceived that a relation existed. I was still faced, however, with one of the central problems confronting composers of contemporary music: how do you organize complex material, especially harmonic material, in a perceptually meaningful but still rich and interesting way? More specifically, how can you make something of this material that would allow the harmony of the piece to accomplish something like the structural/functional role that tonal harmony fulfilled? Moreover, how can you do this without returning literally to the tonal paradigm, since the materials to which I am drawn are certainly not usable in that context?

Ultimately, I believe that musical form needs to be built out of tension and release, both at the phrase level and probably at the longer formal level. To do that, I believe, a composer has to be able to create degrees of hierarchy. I think the greatest error of the serialists was their decision to flatten the level of dissonance, making harmonic tension relatively homogeneous throughout a piece. I suspect that by doing this they essentially allowed only short works to function, because they had given up on the organizational power that harmony offers to form. I realize that many people probably would not agree with this assessment. However, I do think it is not coincidental that many of the most admired serial pieces are very short or depend on text for their formal structure. The perception of form in a piece is completely different for short time-spans than it is for longer works where long-range perception takes over our formal impression from short-term evaluations. In a longer piece, it is extremely difficult to make a form without those vague sensations of a slightly clenched or relaxed gut that we feel more than hear; in a work without a text, or extra-musical referent, I know of no way to really create those sensations except through some sort of harmonic function.

Closing the parentheses and getting back to the actual piece, I had this set of chords whose general character I was happy with. However, in spite of the lengthy process I used to produce them, they were essentially found objects. As with any found (as opposed to generated or constructed) material, it is very hard to know in principle how to organize them because we cannot use the parameters of their fabrication as clues and we cannot easily generate intermediate objects. I thought about ways that I might structure this set of aggregates, post hoc, so as to get some basic sense of their relative tension—since ultimately I view harmonic motion as motions of

tension and relaxation. Because the chords were quite uniform in register and somewhat uniform in polyphony, I decided that the virtual fundamental of each aggregate ought to give me a good proxy for its harmonicity and ultimately a way of evaluating its tension. First, I analyzed the virtual fundamentals of these chords **[Example 3]**. In some cases the fundamental you see is in fact the real note that was being played, and in some cases it is not. What that means is that, because of the bow pressure, or vibrato, etc., at that point in time the spectrum was distorted enough that the actual fundamental's harmonic series was no longer the best approximation of the fundamental for the notes present, within a given tolerance. If the harmony has become more rough and distorted, a lower "virtual fundamental" will be needed to account for the pitches of the aggregate. Additionally, in a few cases the sounds might line up in such a way that a higher "virtual fundamental's" series could account for the aggregate. It is important to remember that a virtual fundamental is not a real fundamental. A real fundamental, if you will, is a greatest common denominator of a harmonic series. All the overtones of a real fundamental are exact integer multiples of that fundamental. A virtual fundamental, however, is a greatest common denominator within a certain margin of error, so that when the sound is very clear (read harmonic), it can sometimes actually generate a virtual fundamental higher than the "real" fundamental (e.g. 381 Hz and 635 Hz might be the third and fifth harmonics of the fundamental 127, but with a large enough margin of error one might wish to consider them as being close to the second and third partials of a fundamental built on 200 Hz—that is, close to 400 and 600 Hz).

Again, while the virtual fundamental is not directly a measure of harmonicity (when dealing with chords that are homogeneous in register and fairly homogeneous in number of voices) it is a pretty good proxy for harmonicity, because "noisier" chords require lower virtual fundamentals. The technique will not guarantee that any chord with a lower virtual fundamental will be more tense than any other chord with a higher virtual fundamental, but it does give you a general indication. My calculations actually produce more gradations than you can see in the musical representation (see **Example 3**), because the calculations were not based on an approximation to the nearest eighth-tone, but made use of values to the nearest hundredth of a tone, which we call cents (cents are cumbersome to represent in musical notation). These virtual fundamentals (approximated to the cent) were used to re-order the chords, in order of descending virtual fundamental—so the chord with the highest virtual fundamental became first and the one with the lowest virtual fundamental became last. In essence, this

gave me an order of generally increasing tension. Of course, voice-leading and other local effects that have always figured into composers' "calculations" still affect listeners' perceptions and can cause the progression from one chord to the next to sound as if tension is decreasing or increasing by too great an amount, regardless of what the virtual fundamentals say. However, I did not really care because I was not trying to use the fundamental values to algorithmically determine chord progressions. I never expected or desired the tension values of the virtual fundamentals to function as reliable quantitative descriptors; I do not work algorithmically per se, and do not need that sort of numerical referent. I wanted a base ordering, with the chords that were more tense on the right in my list, and the less tense chords on the left. I wanted to know where to look for the next chord.


Example 3. Virtual Fundamentals Calculated for Each of the Aggregates Shown in Example 2 (Approximated to the Nearest Eighth-tone). Notes in the lower stave of each system sound two octaves lower than written.

If I wanted tension to rise a little I looked at the nearby chords to the right, if I wanted it to rise a lot, I looked further away in that same direction, and for relaxation I looked left, etc. Beyond that, I used my ears. No matter how much calculation is involved in their music, composers should never be ashamed to do that. In the end, you have to use your ears—that is what we do. Here is the list of chords in their ordered state that I perceive as generally increasing tension **[Example 4]**. If I am right, from chord to chord you will not necessarily hear increasing tension; rather, you hear a sort of spiralling, with tension going up and down as voices move differently, yet the underlying general feeling is one of slowly increasing tension. At this larger scale, there is a real directionality to it; you feel gradually increasing tension as the progression moves from its beginning to its end.

238
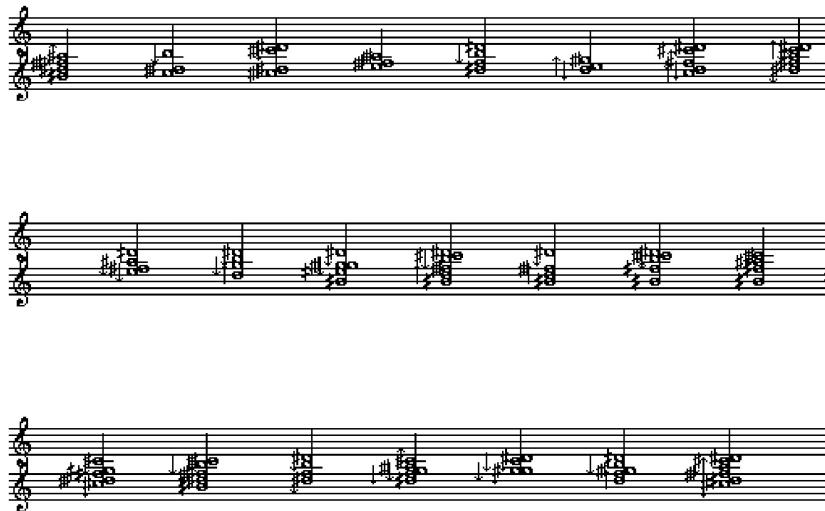
Example 4. The Same Set of Aggregates as Shown in Example 2, but Now Sorted in Order of Descending Virtual Fundamental.

At that stage, it was really this general impression of directionality that I was after. Ultimately, however, this was not what would make the actual piece function. I wanted this base ordering to allow me to create progressions that generated perceptually salient impressions of rising and falling tension. Of course, within an actual piece harmony does not need to create these impressions unassisted—there are other tools at your disposal, such as dynamics, duration, orchestration, repetition, etc., and all of these tools can be combined with the pure harmonic information to generate the necessary tension contours. **[Example 5]** shows one of the PatchWork patches I used to manipulate these chords and includes the general curve of a progression from the piece—though in fact I actually put in another little echo spike of tension, which you do not see on this graph, just before the final chord. This progression begins with fairly high tension, goes down, then rises up to the peak of tension, and comes back down with one more mini-peak you do not see here until it reaches the point of least tension. The ability to create simple harmonic progressions with perceivable tension contours was the whole purpose of going through all these pre-compositional steps I have been describing. I was trying to create the tools needed to

fabricate this sort of functional harmonic progression with my novel harmonic material **[Example 6].**

```
anqls2A
 buff
   a
buffer

      >      8700        (198 151 173 292 180 232 363 612)
  list                   const
list-filter                      list  500      tlist vl/bp
                                 g-scaling/max
      <      6000                0     dxs
  list                           dx->x
list-filter        chords 100
                   75     100                        bpf1      a   B
  chords 200       0      1
  210    100       virt-funds E A     l1?  10
  0      5                              g+
anal-chds  E A     chord 12
                   virt-fund    E            list  l-nth
                     list                    posn-match        chords dels
  list                enum                                     durs   vels
enum                                                           0      5
                   l1?   l2?      (19 18 16 21 15 14 13 12)    sequence  a E A
                   x-append  E    const
  en-ob patch
    arg                                                (100 120 109 78 106)
  pwmap      E           chords 200                    const
                        210    100
   lst  >               0      5
  first                 ordered chd E A
sort-list   E    <      6000
                   list
                 list-filter
```

Example 5.   One of the PatchWork Patches Used to Manipulate the Aggregates, Featuring a Tension Curve Used to Help Design One of the Piece's Chord Progressions.
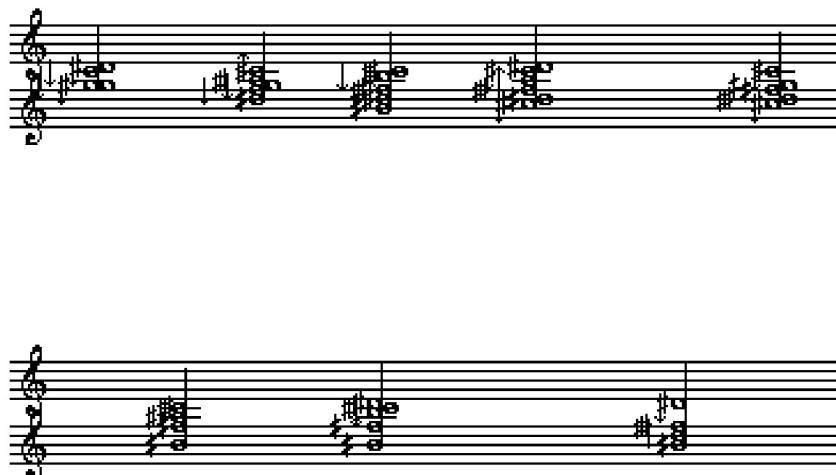
Example 6.   One of the Actual Chord Progressions from *Streamlines*. Note that chords no longer have equal durations (here duration is shown proportionally).

The work I described above pertains principally to one kind of music in *Streamlines*. The piece works with two general states: turbulent and calm. The techniques I have been describing were used primarily to compose the calm states. The turbulent states were built with a quite different harmonic system that, unfortunately, I will not have time to go into today. But before we move on I want to emphasize that in this context of a somewhat technical conference, I have described technical procedures; however, I do not want to give the idea that these technical concerns are necessarily the driving force behind the piece. I really begin with the sonic image and the general sonic-world that the piece will inhabit. Then, according to that image and the sound-world that I want to create, I try to develop the compositional tools I think will be necessary to build that world; thus I try to build a piece-specific language as well adapted as possible to the specific goals of the particular work. Some of these global sonic considerations are very clear. In *Streamlines,* perhaps the most striking example is the extreme imbalance in register: almost everything is high, until very late in the piece. This registral asymmetry was a big part of the work's initial conception, and is even reflected in its instrumentation: *Streamlines* is scored for two flutes, clarinet, piano, percussion, two violins, viola, and double bass. This is an unbalanced

ensemble to begin with; in addition, the two flutes play a lot of piccolo, and the bass plays only harmonics for the first half of the piece, exaggerating the effect even more. Of course, there were other, perhaps more poetic, considerations I do not necessarily need to go into right now. I am trying to give a few glimpses into how the piece was made, like those frequency analyses, which gave me different snapshots of the way the bass spectrum evolved through the extreme playing techniques. However, I think it is ultimately best to let the piece as a larger object take on its own implications. The only way for that to happen is through hearing it.

As I mentioned at the beginning of the talk, *Streamlines* represents a sort of music I spent a number of years trying to be able write: to make a piece like this, I had to learn how to create temporal processes capable of creating strong formal impressions, almost like those created by common-practice forms. I did not expect or want these forms to replicate the specific affects of tonal forms, but I did want these forms to be capable of playing a similarly functional role in the musical discourse. For example, there are big explosions of energy in *Streamlines*, but in the beginning one tends to hear the content of these explosions—the fragments and gestures. As you approach the climax of the piece, however, because they are shorter and I change the way the percussion works, how much the notes are controlled, and how much resonance there is relative to variation in the harmonies, one starts to focus less on the content of each section and begins to hear the sections more as blocks. In fact, the relative lengths of the sustained (slow) sections in comparison to the more active sections starts to generate an almost audible impression of rhythm. In other words, the formal rhythm becomes a sort of surface rhythm. I had been thinking about that kind of process which transforms perception over the course of a work for a long time; to achieve it I had developed techniques that kept all of the gestures and materials extremely tightly related, maybe too tightly related. What I later came to find somewhat frustrating was that many of the subtle differences that might be very important to me at the table when I was taking three weeks to work out four bars, ended up being averaged together and somewhat lost for listeners. The active states were primarily heard as active states and the calmer states mostly as calmer states—the myriad details I had lovingly elaborated added to the general sense of richness, but did not engage really specific impressions and memory.

Think about an everyday process that is really enjoyable, such as taking a walk in the woods. Ultimately what makes a single iteration of the process (one walk) special is not the process alone; it is to some extent the memorable, unusual, highly specific things that you find on the way. In

242

working to create a language that allowed me to create formal process and progression, I had eliminated, at least temporarily, some of the elements that allow moments in a piece to become specifically memorable for listeners. I began to feel that engaging this other more discreet, less continuous kind of perception could be a very powerful formal tool as well. I suspect that part of my original movement away from this sort of perception goes back to the fact that I am not a big fan of melody. I do not know what the psychoanalytic origins of it are, but it has always been very hard for me to come to terms with melody, especially melody that in any way resembles 19th-century melodies; they immediately sound clichéd to me. I understand that this is my problem, but as I am the one who is writing the music, I can only confront materials on my personal terms. However, after 1995 I decided that I needed to come to terms with this difficulty. It seemed very clear that in terms of human perception, melodic elements are extremely memorable: humans are very good at remembering melodic profiles over time. Thus they can create the kinds of landmarks I wanted to integrate into my musical forms. For almost two years, I decided to force myself to deal with this problem by not letting myself write pieces for ensembles where the kinds of harmonically driven processes I had used in *Streamlines* were possible. Therefore, I wrote several solo pieces. Especially difficult for me at the time, I wrote a solo piccolo piece, *Breathe*. I used these solo pieces, including some for piano, as a way of really coming to terms with how I might find things that were analogous to melody, or that functioned like melody, but were not exactly melody in the older sense, or at least did not evoke the sense of foreignness that had previously prevented me from integrating too much surface linearity in my music.

Approximately three years after the premier of *Streamlines*, I finally felt ready to go back to writing a larger ensemble piece without falling back into the kind of writing I had already done with my earlier ensemble pieces. I had a Radio France commission that I had delayed several times while fighting these internal battles, and this was ideal because, while they had fixed the number of instruments, they left some flexibility in terms of the specific instrumentation. I came up with an ensemble that I felt would force me to keep pushing forward into this new compositional terrain—it drove them batty, though, because it turned out to be very expensive for the premiere. I decided to write for two harps, with one of the harps tuned a quarter-tone down (so the two harps actually form one sort of quarter-tone super-harp), and an ensemble of six instruments. The two harps are seated in front with the ensemble behind. It seemed to me that it would be impossible to rely on slowly evolving harmonies with solo harps, especially if I used the

harps without amplification. The two harps would force me to work figuratively and gesturally, at least to some extent. I surrounded these harps with a set of sustaining instruments: two flutes, clarinet, violin, viola, and cello. Essentially the idea was that those sustaining instruments would be like a soundboard for the harps, but a soundboard that could be controlled; I thought of it as an "intelligent" soundboard. As very often is the case, when I started the piece I had a very specific structural constraint created by this idea of the harp with an intelligent soundboard, which I hoped would push me to find new solutions to the formal problems I was hoping to address.

Something I do not talk about often in professional situations is that I also almost always have a poetic idea that helps guide the early stages of each piece. In this piece for Radio France, I was very much inspired by the notion of Japanese Zen gardens, which are made of rock and sand. Specifically, these Zen gardens seemed to me a perfect illustration of the formal process I was seeking that would combine memorable objects with slowly evolving processes. The principle behind these gardens is that the raked sand, which is often meant to represent the ocean or the universe beyond the ocean, is encrusted with a very few, very specific, often found objects (often large craggy boulders). The idea is that the sand does not mean anything without these incrustations, even though the two types of design elements are not viewed as being continuous in any way: they are conceived as totally discrete things, which nonetheless completely transform each other.

Two additional aspects of Zen gardens also very much appealed to me in the context of the piece I was imagining. One was the very process of raking the sand. Often the sand of these gardens is raked into relatively complex patterns. What interested me in this process was that it is not the raking itself that is important; rather, it is the pattern left behind after all of the successive passages of the rake. This seemed to me a powerful analogy for what I wanted to do musically with the harps: their attacks would transfer energy and material into this active sounding board around them, but the harp figuration ultimately might be less important than the traces that would remain after all of the successive passages had become part of that more continuous world. The other notion from these gardens that became important for the piece was a particular idea of contextual framing. You cannot walk on most of these Zen gardens because you would disrupt the patterns in the sand. They are meant to be viewed from porches, and in some of them the porches are laid out in such a way that you cannot see the entire garden. As you move along the porches you see, in a sense, different gardens that are all made out of the same elements. The objects are recombined into different constellations, depending on the viewing angle

and what parts of the garden are currently visible. In a certain sense, each of these objects takes on different "meanings," depending on the roles they assume in each of the viewed constellations. This too seemed very close to what I wanted to do with the piece. I was trying to find a way to allow really continuous processes and very foreign incrustations to develop multiple interdependent relations, and it was clear that this would require the use of some sort of framing which made use of juxtaposition, memory, and context.

I also used some specifically sonic ideas borrowed from Japanese traditional and court music, to help me make a sonic world that evoked the right general ambiance and to help prepare the possibility of hearing relations between the found objects, that had very specific links to Japanese music, and the processes whose links were more diffuse and transformed. One example of the way traditional Japanese music comes into the piece is in the use of a compositional model built by studying the *ryuteki*. The *ryuteki* is a flute used in the interludes of *nōgaku* music (the music that goes with *nō* theatre). Though there are many other bamboo flutes used in Japan, this instrument has a very particular sound because in the head of the flute there is a short lead tube with a different diameter from the rest of tube. The story, which is surely apocryphal, is that centuries ago a flutist broke his flute on the way to a rehearsal and repaired it with another tube; supposedly everyone was so taken with the result that the instrument remained in use. In this flute, the presence of two tubes with different diameters, both in contact with the air stream, at times creates two standing waves that interfere with each other. The result is a very particular doubleness and instability that sometimes appears in the sound. For the piece I did not want to limit myself to the extraordinary specificity of this instrument, but I wanted to infuse much of the flute part with some of this rather magical behavior. So I created a model of how the two parts of the *ryuteki* spectrum interact and used this model to create much of the music played by the two Western flutes in the piece. The result is that, just as the two harps are often heard as one super-harp with microtonal capabilities, the two flutes often become one sort of super *ryuteki* where both flute lines together fill out a singe "part," without the range or intonation limitations of a real *ryuteki*. The piece is called *Recueil de pierre et de sable* (Collection of Rock and Sand), the title is taken from that of the oldest book on Zen gardens which was written by the Zen monk Muju Ichien (1226-1312), during the brief theocratic rule of Japan from Kamakura.

DISCOGRAPHY

Joshua Fineberg: Streamlines, Tremors, A Ripple-Ringed Pool, Paradigms, Breathe, Recueil de pierre et de sable. 2002. Performed by the Ensemble Court-Circuit, Pierre-André Valade, cond. Paris: Accord, 472-363-2. Compact disc with 27-page booklet in French and English.

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DISCUSSION

Onur Türkmen: What was the biggest difference between *Streamlines* and *Recueil de pierre et de sable*? How do you think about the musical form in those separate pieces?

Joshua Fineberg: For me, the form is extremely different. In *Streamlines*, the process essentially **is** the form. Though it is a complex process with multiple layers, one can in a certain sense understand everything in the piece as playing a role in the process. The processes in *Recueil de pierre et de sable*, however, are disrupted by those incrustations I described. Moreover, while those foreign objects strongly influence the perception of the formal processes of the piece, I do not believe they can be explained in a meaningful way as a part of that process—their role is to be outside. They are objects that were placed in the piece in order to frame the listener's perception of it, but that aren't organically part of it.

TIME AND FORM IN SPECTRAL MUSIC

Tristan Murail

What I will try to explain this morning is that the so-called "spectral music" is not only about spectra and timbre but also about lots of other things. You have had or will have spectral music presentations, which mostly focus on aspects of timbre and spectrum. I think, however, that one of the most striking aspects of spectral music is not there, but rather in the way that time and form are handled in this sort of music. Of course, there is a relationship between both, and I strongly believe that you cannot really separate form from so-called material. In fact, when I write music I do not really think in terms that I have on one side material I can use, and on the other side form. For me it is one thing. I think that is one of the important aspects of the kind of music I, and some of my colleagues, are trying to write.

The second thing that I wanted to tell you is about how things happened when we started dealing with these concepts in the late 1970s. I am thinking very much of my colleague and friend Gérard Grisey, who in fact should be here today, but as you know he died five years ago, which was an immense loss for French music and for music in general. I would like to explain a little bit first what happened in those early years and the way we came to these strange ideas about building scores from a study of timbre, from the idea that timbre could be a constituent of form, the nexus of it.

I think that the first real spectral piece, in this meaning of the word, was a piece by Gérard Grisey that he wrote in 1974, called *Périodes*. At that time, we had just founded a group in Paris, which we called l'Itinéraire. With this group, we played all these early spectral pieces. Even in that first piece, there was a preoccupation about time more than about spectra themselves. The piece was based on the spectrum of a trombone. Gérard Grisey had found the analysis of a sound of a trombone—a low E—and he based the piece on the harmonics of this E as you find them in the sound of a trombone. In addition, there were many other aspects of the piece; in fact, the piece is all about inhalation and exhalation, so it is like a long breathing

form. The form of the piece is something like this: you have a series of inhalations and exhalations.

That was 1974, and a year later, he wrote a piece that became a kind of paradigm or model for spectral music, called *Partiels*, but I will not say more about it because we have a presentation of this piece by Chris Arrell. This piece is a bit of an extension of the concept of *Périodes.* It is also based on the same sound of the trombone, and in this piece he produced many new spectral techniques.

In fact the most distinctive feature of the music of this period—*Périodes, Partiels*, and also a few pieces of mine which I will introduce now—was not really the timbral aspect, although it was in a way, but also the form of the piece, which was mostly relying on the concept of processes. What is a process? It is quite a simple thing: you have a musical situation, it can be a musical object, as I will try to define later; it can be a texture; it can be anything. Let us say that you have Situation A, and are going to Situation B; the process is that you are just going from A to B in a fairly continuous way. Especially in these pieces, we tried to be as continuous, as progressive as possible in the processes. You have heard some of my pieces already [at the conference], especially *Ethers,* demonstrated here by Michel Galante's group and played in a concert. *Ethers* is a typical piece of this period, where you have exactly these kinds of things. For instance, in the middle of the piece you have a series of multiphonics on the flute and scratch sounds on the strings, so you get a complex chord there and it goes back to harmonics, *sul ponticello*, et cetera; it goes back to high pitches. The thing is repeated in a second wave after this first wave. It is accelerating a lot during something like two minutes, and at the end what you get is a very, very fast series of notes—a very fast run in thirty-second notes. Each note of this run corresponds to one of the waves that you had before. Here the process was like going from waves lasting approximately twenty seconds, to durations lasting something like one-tenth of a second. You also have processes about pitches, timbres, et cetera. This idea of process was meant to replace the old idea, the old concept of development. One thing we did not want to do was to have a thematic cell, a *thema*, and to do variations on the *thema* the way tonal music did (but also like serial music did). We wanted to have a manipulation of time where this kind of thematic development would not have a place—easier to say than to do. The process idea was one of these ideas we used in order to do that. We were very much afraid of falling back into old concepts of rhetoric in music, so that was the reason why.

Now that that time has passed, I can see that the music we tried to do at that moment was in opposition to the serial music of the time: there was a

very strong influence of Boulez's ideas in France then, and we were opposed to those ideas. At the same time, however, we did not want to go back to old concepts like tonal music or neo-something—neo-romanticism or neo-classicism, as other composers were doing in other countries, such as Germany or the USA. The idea was to find another way.

I composed *Treize couleurs du soleil couchant* (Thirteen Colors of the Setting Sun) in 1977 or 1978. This is one of the pieces of mine that is most often performed, because it is considered a kind of paradigm of spectral music, but in fact, it is not spectral at all. I will try to describe what it is. The important thing is the number thirteen; it has thirteen—not sections, but processes, in the piece. Let us call them sections just for convenience. Each section is based on a different interval—so that is not spectral at all—for instance, at the beginning of the piece you have this interval, so that is section one. The second is based on that interval, and so on.[89] You have higher and higher frequencies until section six, and then lower and lower until section thirteen. When the pitches are high, the intervals are smaller, and when in the low register the intervals are bigger. This is spectral in a way, because in a spectrum you find that the high pitches are closer together than the lower ones (in a harmonic series). The piece is written for five instruments—it is called a "Pierrot" ensemble—with flute, clarinet, violin and cello, and piano. Most of the time, these intervals are used by the woodwinds, the flute and clarinet; the role of the other instruments, especially the strings, is to modify and distort these intervals, or add things to them.

This is a very important concept in this music. For instance, let us go from the second interval. This section uses the idea of ring modulation. If you have two pitches, A and B, and you ring modulate them, you get two sidebands. One of them is called the additional pitch; the other one, in this case, would be the differential. If you calculate those two additions and subtractions of frequencies, in this case, we get something like a low G, which would be the addition of the two frequencies, and the subtraction would be something like this—these are not precise—it is around a C♯ and around a low G here. In this piece these two pitches would be played by the strings, for instance, so they would be added to this interval, and then other things will happen which I am not going to describe now. The idea is that you use these simple pitches, but you derive many things using processes like ring modulation, harmonic transposition, et cetera.

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[89] [During the presentation, Murail projected various illustrations, including score excerpts.]

249

This is how you go from one interval to the next. The idea is that you add many modulations to this and get a new situation, which will be section three, and the process will be repeated. At the beginning of each section, you have a clear harmonic situation where you very clearly hear these intervals, and you hear clear pitches. In between, however, you have noise-like sounds, for example, when you have a bow and add pressure on the strings, multiphonics on the woodwinds, et cetera. The idea or metaphor is that when the sun is setting, you have many colors—red, yellow, orange, et cetera—but you do not really see where they move. When you look at the sky, you do not really see that they are moving, but there is a process going on. If you take a series of snapshots, you can see that the colors are different from minute to minute, but when you watch it, you do not realize it. This was the metaphor for the piece. Sometimes when you have these shadows of the sound, it is like a cloud obscuring the sun.

In this sort of music there is quite a bit of repetition. The cells, or objects, as I said before, are never literally repeated, but always transformed in some way. Most of the time the tempo is not stable, for instance. It is always either accelerating or decelerating. There is a kind of relation with American minimal music: you have this idea of repeating structures, going in-phase or out-of-phase like Steve Reich. At the same time, it is very different, because the harmony fits very differently, and there are processes at several levels. You have processes about the form, the shape, the rhythms, as well as what I said about the repetition and the way the time is moving. In addition, there are also processes that are affecting the timbres and harmonies in the case of this piece.

Gondwana, a piece I wrote two or three years later, in 1980, is a piece for orchestra. Here again, I do not know whether one can say it is a spectral piece. It uses spectra, but not in the usual way one thinks about them now. When you think about spectra, many people think you take the sound, analyze it, and try to reproduce that with instruments. That is not exactly what I was trying to do. This is the idea of the first section of the piece: at the very beginning, I wanted to create bell-like sounds with the orchestra. You imagine the entire orchestra playing the components of a bell—not a real bell, but the components of a bell. You have a very sharp, percussive attack, and then you have an exponential decay, or resonance—the resonance of a bell is of this type. This is reproduced by the instruments of the rest of the orchestra by means of different dynamics, and also the orchestration is very open, to create this effect. At the end of the section, I have this different profile, which is more like a brass sound, where you have a soft attack, with a peak that corresponds to the "wai" and "waa" of the

brass sound. Then you have a steady state, where you do not have blowing into the bell sound, and decreased resonance. There are a number of big sounds like this created by the orchestra throughout the section, and what we call interpolations in between this shape and that shape. In the middle, you have sounds that have softer and softer attacks, whereas the steady state, the plateau, is both.

At the same time, when you have a bell sound, it belongs to the category of the non-harmonic spectra, which means that the spectrum of a bell does not really follow a regular harmonic spectrum; there are pitches added to the harmonic spectrum. At that time, I did not have tools like computers with which to analyze the sounds. So what I did was use the technique called frequency modulation, which was known in computer music at that time, and with which people created bell-like sounds—but they are not real bells, they are very imaginary. In fact, it is a mathematical process, which creates spectra or harmonies or timbres.

This is the beginning of the piece, with bell-like spectra. At the end, you have brass-like spectra, which are more harmonic. You start from a non-harmonic situation—this is equivalent to dissonance in tonal music, if you like—and progressively we go to a harmonic situation, which is corresponding to consonance in tonal music. When I say that, I am comparing the functions of dissonance and non-harmonicity—I am not comparing the actual thing, but just the function.

In terms of pitches, I got complex chords with lots of microtones—I can try to play that with the computer's sound but it will be very ugly, I warn you **[CD 1:8]**. The last chord is less dissonant than the other ones, because it is based on the harmonic series. These huge chords are orchestrated with the low part of the chord played by the brass instruments and the high part by woodwinds, for instance. I did not use strings because the strings have too-complex components. There is a very intimate relationship between the harmonies I use and the timbres I use to derive these harmonies. If I orchestrate the spectrum, the instruments will add their own spectra to the harmony, so I have to be very careful of what instruments I am choosing when orchestrating such a sound. Perhaps the best thing now is to listen to the actual beginning of the piece; it will be better than the computer simulation, I'm sure.

Gondwana is the last piece of the first period of my approach to spectral music. I will try to explain why. When you have this idea of processes, going from one point to another, it is very powerful, in terms of conception, but at the same time very predictable. Once you are used to the idea it is not necessary to go to the end of the process! I suppose it was necessary to go

through these experiences at the time. For instance, there is a piece by Grisey, which is in a way extraordinary, because it is one process from the beginning to the end of the piece, *Jour contre jour* (Day against Day, or Light against Light). It starts very high and ends very low. Here it is non-harmonic, there non-harmonic in a different way, and here, not really in the middle but more like the Golden Section, it is harmonic. There is a series of goals for the spectrum throughout the piece; there are small processes going from one end to the other as I explained for my piece, *Treize couleurs*. Basically, however, it is one trajectory. It is extreme and very powerful, but something you do only once, or you just repeat yourself. I think Grisey was wise enough not to reproduce the same scheme repeatedly.

We had lots of discussion at that time about form and about time, to understand that if you go from A to B, you are not obliged to use the most direct way. You can zigzag throughout it, or you can summarize and shorten it. I used this in *Gondwana.* There were several sections where I just did that, so you have a series of snapshots of the process, but you do not have the process entirely. That was one work, and a few years later I wrote a piece called *Time and Again,* where I really used this idea a lot. The piece is always linear and going forward—no flashbacks, repetition, et cetera, because we do not want to use over again the old forms that you have in tonal music. You start by writing the piece like this, then you cut it into pieces and you shuffle things around, so this will come here and this will go there, et cetera. This was the idea of the piece, and some of the fragments were repeated later, with or without transformation. For us it was a great novelty. We did not dare do that before because it was like repetition in tonal music. In fact, however, it is very powerful, because when you do a structural process, you do not make use of memory: you do not have musical objects or forms that you remember, and that you later repeat and which take a new signification in a different context. This is a very powerful tool to build forms. This was something that I wanted to reintroduce in my music, but very carefully. This is one of the ideas I used at the time.

Attracteurs étranges is a piece written in 1992. In this piece, there are several concepts I would like to explain; I will explain some of them with the computer. There was the concept of fractal form. I think it is quite well known nowadays—less so in 1992. In a fractal, you have a shape and a series of segments; and each segment repeats the same shape. This is fractalization, and you can repeat the process of each new segment until you reach the level of atoms and molecules. I did not go that far with my piece, but I used these concepts, not to organize pitches or rhythms—because I do not believe these kinds of things really work—but to organize certain aspects

of the form of the piece, especially in order to organize the repetitions of objects.

This is the second concept. What I call a musical object is something that is quite striking, that you can remember as an entity. This is something I have not mentioned before, but it is very important for understanding this kind of music. On the one side, there is the observation of timbre, of natural things with timbre, acoustics, et cetera. On the other side, there is a preoccupation with psychology, and the way we listen to sounds and music: the perception of sounds, psychoacoustics, or cognitive sciences. We think a lot about how you actually perceive music: how you perceive duration, for instance, and how memory is working. For example, we know, more or less, that if a sound or musical object is too long, say longer than approximately three seconds, you no longer hear it or memorize it as one single object, but as a succession. You have to grant what we call a segmentation. You have to divide; it is an obligation. If it is shorter than that, it can be understood as one thing. For instance, the first four notes of Beethoven's fifth symphony is a typical musical object. It is very short and striking, so you remember it, and can build a form with it. It can be anything: a melodic cell, a timbral object, a noise, a varied structure, a complex musical pattern, or a texture. You can submit this object to lots of transformations, and the idea is that you can change the object so much that you get something quite different at the end, but you still recognize some properties of the object. You create a collection from conception. In other words, objects can be submitted to processes, and this is the connection with the older idea of processes.

Another piece has the same idea. This shape has nine segments. I reintroduce the same shape under nine different segments, and then I get this very complex shape. Using zero shows the basic shape. Now I do my fractalization once and I get more complexity. If I continue, I can work through the same idea again. This was the idea of the piece. Each segment presents a duration or proportion. With this piece, you would have nine sections—I use the word "section" because I do not have a better word, but they are not really sections. Nine sections divided in turn are again divided into nine smaller sections, which in turn can be divided into nine sections that are no longer sections, because they are so short, they are rhythms, in a way. This is the way I approach duration and rhythm. For me, duration is like a small form. It is not like rhythm—I do not use, for instance, a preset rhythm, to which I will add pitches. I think this is a silly idea at this point, because if you add a timbre or pitches to a series of durations, in fact you change the perception of this series of durations. It is no longer the same. In other words, everything is connected in music. In the time of serial music,

253

people divided music into parameters: pitch, intensity, duration, and timbre. First, timbre is not a parameter, because timbre is the place where all parameters meet. Second, you cannot really disconnect duration, pitch, and intensity from one another. Rhythm and frequency are the same thing. Intensity and frequency are the same thing. Harmony and timbre are the same thing, or rather, different aspects of the same thing. I am strongly against this idea of dividing things into parameters. For the same reason, I will not compose in several steps: first the rhythms, then the pitches, then the orchestration. For me it is all one thing. This is about the structure. Of course, when I start something like this, I never stick to the model; it is just a starting point, a guideline.

Now let us go to another piece, *Serendib*. This is for 22 instruments, so it is quite a big work. You do have spectra, which constitute the objects. On a page, you have maybe three of them. You can see the shapes; the pitches do not matter. The bulk of the spectrum is here: the brass with the *sforzando*, "waa." The shape of the flutes looks like a melodic line, but in fact it is not. The melodic line of the two flutes reinforces the contour of the sound of the brass. The flutes play the harmonics of the brass, and just make it more precise; but of course, if you slow down this thing and isolate it from the brass, you have a melodic line. This is a complex musical object, with the brass here, the flute here, combined with the resonance of the percussion and strings. This is one object, but now if I start dividing things into parts, I get many subtle objects that I can use in the composition. This is the concept of the piece.

Here is the sound object from *Serendib*. The important thing is the beginning of the sound **[CD 1:9]**. That was my object, and now please listen to a few transformations of this object **[CD 1:10]**. The little staccato run in the woodwinds here is like the development of the extension of the flute pattern that we had in the first object. This is clearer, of course, if you hear the section between. This happens at Rehearsal C, but before, this object is anticipated by smaller versions of the object that have virtually the same shape. **[CD 1:11]** is one of them. In fact, it is the same. The brass here are reduced to two horns, but the flute parts, string parts, and harmonic color are derived from the same spectrum. This is pre-echoing the object that appears at Rehearsal C. Section B ends with a succession of such smaller objects leading to C **[CD 1:12]**.

Perhaps I should end by showing something from Rehearsal J. J is one of the subsections of the fractal form, and it is in turn divided into J1, J2, J3, J4, et cetera. J3 is subdivided into five letters, A, B, C, D, E—these are the fractal core objects of the piece: medium duration, short, medium, shorter,

and long. You have this pattern throughout the piece. Here it is very explicit; it is really the middle of the piece; that is the reason why. J3-C is again divided. G has a duration of 20.9 seconds—I always think in seconds, not in rhythms—so this is the duration of G3. G3 is divided into these five small instants. J3-C, then, lasts 5.2 seconds, and these 5.2 seconds are divided into five chords. The Greek letters alpha [A], beta [B], gamma [Γ], delta [Δ], and epsilon [E] mark the five proportions of the fractal series but they have been permutated—the order has been changed at this level. Nevertheless, you have the same proportions. This represents a small rhythm; I think its speed or something like this, which follows more or less the same pattern, but freely.

You have the same division at all levels of the score, which was an interesting intellectual challenge. I do not expect, however, that listeners will realize that, because rhythms and form are not perceived in the same way. We do not use the same kind of perception and memory in order to appreciate or remember them. Psychologists distinguish a difference between long-term memory and short-term memory, for instance. Musical objects are apprehended or understood through short-term memory, whereas global form, musical form, is remembered or understood with the help of long-term memory. These are not the same at all. I do not believe too much in the correspondence between the macro things and the micro things—the macrocosm and the microcosm. It is interesting to do it as a composer, but I do not expect that people will realize that this has been done this way. For me it is a way of creating things and getting coherence. **[CD 1:13,** *Serendib* J2 to J4.**]**

DISCUSSION

Audience #1 (Robert Reigle): You talked about material and form. Could you also tell us how you conceive of content or meaning?

Tristan Murail: Content or meaning, yes [laughs]! I think music doesn't mean anything [laughs]—this is a very good answer. I will quote Stravinsky, who thought something like that. He said, I think, that music couldn't convey emotion or something of the sort. What I mean is, you do have emotions or meanings, but they are very specific to music. So you use these words, for a lack of better words, like language—music is not a language in the ordinary sense, but it does have some kind of linguistic functions, too. But you cannot say that just with words, with ordinary words, and I suppose this is the reason I write music rather than novels. It is

255

because music is something intrinsic; I don't know about meaning, but I can feel it. When I write music I write, I work, I change, I rework, until the meaning of what I'm doing satisfies me. But I don't know what meaning means [laughs].

Audience #2 (Michael Ellison): Can I ask about your conception of musical objects? What I'm wondering is that you showed us this very complex, orchestrated passage—the horns with the flutes above—how far does that musical object extend? Would it be the entire, orchestrated passage, or would you have a kind of polyphony of the sound objects?

TM: In this case, yes, with the example I played, it was the entire thing. Because I think that when you hear it you cannot dissociate things—it's too complex. Very often, the musical objects or aggregates of sounds I use, if you look at the score, or other way—an electronic sound has been made, they are very, very complex; but when you hear them, they are very simple, because they are one thing; they are one entity. Well, this is a very spectral concept, in fact. If you analyze a sound, for instance the sound of a voice, it's very, very complex. But when I say a word, it's very clear to a simple view. In fact, this is a feature of nature, in general. Natural things are very complex if you try to analyze them, but when you just perceive or look at them, they are very simple. A tree is a very complex shape—but the tree is a tree at the same time. So this is how I can see these objects. At the same time I can stop analyzing them and tearing them into pieces. Discussing, yes, I will separate the roots from the plants—and this is what happens in the score, in fact.

Audience #3: You use different objects at the same time as a kind of polyphony?

TM: Yes, yes. Sure. In this case, I used a simple example. But in fact, right now I am working on an orchestral piece that is exactly about that: how to use lots of complex objects, put them together, superpose them … so it's a new way of approaching counterpoint. I hate classical counterpoint [laughs]. Of course, I think it is very scholastic, but this kind of counterpoint I am very interested in: how you can superpose things. When you have these complex objects, they have their own meaning, in a way, because they have an internal syntax. So they are very strong, and they are very hard to manipulate. But I am interested to see how I can actually manipulate them, superpose them, et cetera.

Audience #4: I want to ask something about your previous answer. What if from our birth, we listened to this kind of music—the objects would be something like a mother tongue for us. Do you think that these objects would also be obvious—like a tree is a tree, this object would be [a

recognizable] object for us? We meet these objects in later periods of our lives, so we can't recognize them so easily, but what do you think if we were to deal with them from the very beginning of our childhood?

TM: Yes, what you are saying is that you can recognize only something you already know, right? So you said the tree you can recognize because you already know the concept of a tree?

A#4: Not only that, but you are born with that concept.

TM: You are born? Well, no. You learned it.

A#4: Well, say you were six months old or a year old, like your mother language?

TM: Well, I suppose this is the difference between art and nature. In art, we probe our new concepts—you know—it's a big issue. It's the dialectic between novelty and understanding. If I propose things that are totally new, from another planet, to you, you will not grasp anything. So you would have difficulty understanding what I am trying to say. Now, if I repeat old things it's not addressing either. We need to have some kind of connection somewhere, some link. It's sometimes very hard to know how you have to introduce a new idea. But for instance, on the practical side, I am very, very careful with the way I start the piece, precisely for that reason, because I think the listener has to get familiar with the universe of a new piece. So you cannot introduce too much at a time. You have to choose bits of information carefully so that people can listen to them, remember them, make connections, et cetera. Very often, the pacing of my pieces is slower in the beginning, and much quicker in the end, because at the end of the piece I assume that people have already memorized things, and they already know what it's about. If I insist too much, if my durations are too long, people will just be bored; they'll say, "Okay, we already know, we don't need all these repetitions." That's one aspect. For instance, in classical music in the [Sonata-]Allegro form, in the score you have these repeat marks. You play the first half of the *allegro* once [sic], the second half twice, because I suppose composers at that time thought it was necessary to repeat things so that people understood: this is the first theme, this is the second theme, now I combine both, et cetera. But nowadays we are familiar with this, and most of the time players do not repeat all that; [they] might repeat bars, sometimes one or two or none. So this is familiarity with something, and yes, it's a big issue. Ceased to be an issue, for now.

Audience #5: I read in the booklet that you studied North African Arabic. Did Arab literature or Arabic studies influence your art and your music?

TM: No, I don't think it did, not in a direct way. I studied Arabic, classical and North African; I also studied Latin and Greek and [laughs] a few other

languages. I'm very interested in different languages, because I think it widens our mental horizons. When you study a language like Arabic, which is completely different from Indo-European languages like English or French, you see [it] as a concept of our life. I suppose Turkish would be the same: it belongs to another linguistic group, Ural-Altaic. I only know English [laughs]. So you have other ways of grouping concepts, of deriving things, so it is very interesting to see how other people think. In this way, yes, it's part of my experience as a composer, but there is no direct influence of, for instance, Arabic music on my music, except microtones, perhaps.

A#5: But you very much think about interpretation, how an audience would think about music.

TM: Perception, yes. Yes. In fact, perhaps this will be the last word. When I think of music, for me music is not a score. The score doesn't represent music. There are composers who think the score equals the music. I don't. I think music is this: when it's really out here, when it is materialized into sounds, and sounds that are perceived by a human ear. Not just sounds, but sounds as they are perceived. So from the original concept of the composer to what reaches the ears and the mind of the listener—it's like a long series of translations, of distortions, sometimes of treasons, you know? You have to be careful with this. Sometimes what I write on the score is very far from what you would expect; I'm thinking not of the score itself, but what will reach the ear and the mind of the listener. Of course, it is easy to say, once again, but it is very, very hard to do, and I don't know how to do it, really; I have to use myself as a guinea pig, as a listener, as a perceiver of my music, in order to do it. Otherwise, I would need to have a sample of people in my home and try things out on them. So I use my own experience—and this is what people call intuition, and things like that. That is the way you actually get experience, especially there: how perception will transform what was given to here, to people.

NOTES ON *DICTIONARY OF WAR*

Mehmet Can Özer

When the invasion of Iraq occurred, I had not realized what had happened. Being a person who lives in a neighboring country, I felt an isolation from the truth. After some time, when things got darker, death, murders, rapes became usual for the world's "independent" media. I tried to compose pieces that acquire the concepts of freedom, democracy, and human rights.

Before composing this piece **[CD 1:14]**, I realized something about the real world. In our daily lives, we are bombarded by unnecessary information. Nowadays no one can fully face up to the true reality. In a short time, everything has been dictated to us either by governments or media; people have lost their own rights. In my composition, I have tried to simulate these oppressive factors in a multi-layered structure. My inspiration came from the invasion of Iraq. I put myself in the place of an Iraqi and took a journey from the sub-consciousness to the "real" world. I found a piece composed by Lars Gunnar Bodin, a text-sound composition in the Swedish language. The reason for this is, no matter how little or how much one knows a language, the simulation of tones and musical ideas can manipulate the emotional senses into an understanding almost unconsciously. This could be an analogy of popular "kitsch" culture; everywhere, every time, directly to our brains, to affect and control.

Sound materials and textures vary from speech to synthesizers, fantasy to illusion, sub-conscious to conscious. I have also included religious elements such as the *ezan* (the call to prayer in Islam), which is sung in different musical modes (*makam*-s) according to the position of the sun. Also included is the Fatiha prayer, which is a common blessing.

It is hard to imagine a war-torn country without having experienced it. If only society could open up and see past the blinkered visions that are perceived to be the truth.

June 2003

The previous text was the original concert note for my composition. Recently Robert Reigle asked me to write about the composition. I had met with him four years earlier and was quite surprised to be remembered. To re-write about my composition has made me think of the events that have happened over the past four years.

In November 2003 at the Istanbul Spectral Music Conference, I premiered my composition *Dictionary of War*. Ironically on the same day, two bombs went off in the city: one at the Hongkong and Shanghai Banking Corporation (HSBC) Bank and the other at the British Consulate. Due to our location at the conference, we could hear both of the explosions. Some of the international guests told me that they had passed the Consulate just minutes before. At the time, none of us could really understand what had happened. It affected us not only physically, but also psychologically. Performing this piece about war and terror, and then for terror to be on our doorstep. Not knowing who died or who lived. Not knowing what to say or do. Confusion, anger, sadness, and fear, all in one soul.

Summarizing the last four years also reminded me of the well-known painting *El Guernica* by Picasso. When he was installing this painting a German soldier came to him and asked, "Did you do that?" Picasso replied rapidly, "No, you did." History loops. With *Dictionary of War* the same situation is valid. It can be understood as a composition of music or vice versa. In my opinion, both are applicable. From time to time, when I critique my own works, I sometimes hear an outsider's aesthetics, strong, intimate, and over-controlled. But in *Dictionary of War* I didn't want to control myself as a composer. It can be said that it is the "black sheep" of my compositions! After its completion, I couldn't bring myself to talk about the technical details, the structure, or any of its musical aspects. It kept reminding me of our implicit obedience for its 15-minute duration.

After the bombings in Istanbul, I felt I was struggling to say something of significance. I could only feel that the maps of the world were redrawing themselves. It was not a dream place to live anymore, for any of the existing organisms left. People don't even want to ask questions—or if, incidentally, they do ask, they don't have enough self-confidence to face the truth. Is it a happy, globalized, modern country, or a country of the blind? Just a final remedy: in the country of the blind, the one-eyed man is king.

Ankara, January 2007

THE PATH TO *HALF-LIFE*

Curtis Roads

A composer does not often pause to explain a musical path. When that path is a personal breakthrough, however, it may be worthwhile to reflect on it, especially when it connects to more general trends in today's musical scene.

My electronic music composition *Half-life* portrays a virtual world in which sounds are born and die in an instant or emerge in slow motion. As emerging sounds unfold, they remain stable or mutate before expiring. Interactions between different sounds suggest causalities, as if one sound spawned, triggered, crashed into, bonded with, or dissolved into another sound. Thus, the introduction of every new sound contributes to the unfolding of a musical narrative.

Most of the sound material of *Half-life* was produced by the synthesis of brief acoustic sound particles or grains. The interactions of acoustical particles can be likened to photographs of bubble chamber experiments, which were designed to visualize atomic interactions. These strikingly beautiful images portray intricate causalities as particles enter a chamber at high speed, leading to collisions in which some particles break apart or veer off in strange directions, indicating the presence of hidden forces **[Example 1]**.

Composed years ago, in 1998 and 1999, *Half-life* is not my newest composition, nor does it incorporate my most recent techniques. The equipment and software used to make it were (with the exception of some custom programs) quite standard. Nonetheless, this piece is deeply significant to me as a turning point in a long path to composition.

261
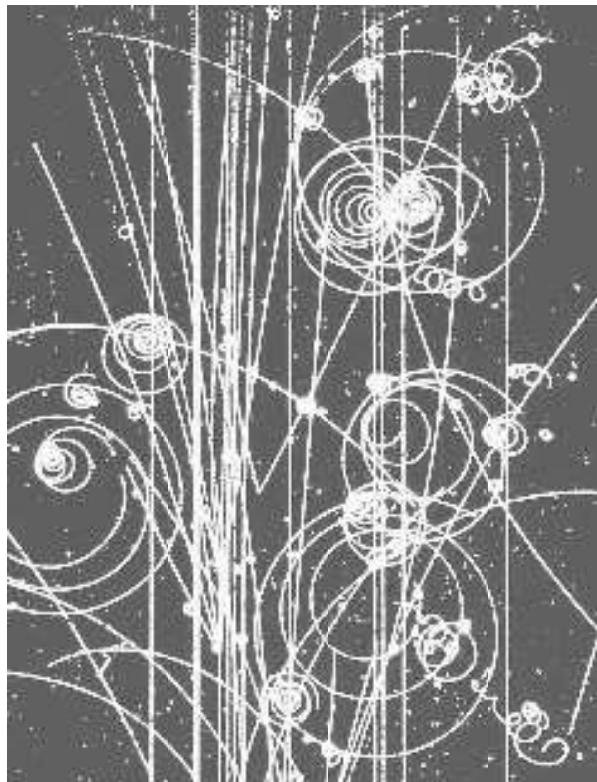
Example 1. Bubble Chamber Image (© CERN, Geneva). A bubble chamber is a type of subatomic particle detector that was used during the initial years of high-energy physics (1955-1975). The device consists of a vessel filled with a transparent fluid that is on the verge of boiling, that is, under a pressure and at a temperature for which it is on the liquid-gas boundary. For hydrogen, this is only a few degrees above absolute zero, minus 273 Celsius. When an ionizing particle passes through a bubble chamber, it initiates a string of bubbles—due to boiling—along its path, which can then be photographed and analyzed.

EARLY EXPERIMENTS IN GRANULAR SYNTHESIS

The notion of sound particles or grains can be traced back to antiquity, but the modern concept derives from experiments of the physicist Dennis Gabor and the composer Iannis Xenakis (Gabor 1946, 1947; Xenakis 1960,

1971; Roads 2002). I first heard about the theory of granular synthesis at Xenakis's 1972 course at Indiana University. I then studied electronic music and computer programming at California Institute of the Arts, but I did not have access to a computer that could produce sound. In pursuit of such a facility, I enrolled at the University of California, San Diego and obtained research grants in order to use the campus mainframe computer. The purpose of this research was to test Xenakis's theory of granular synthesis, which had never before been programmed. Beginning in the autumn of 1974, I realized nine technical studies in digital synthesis. Each study involved multiple steps: programming on paper, typing punched cards, waiting for calculation, transferring the calculated data to different media, and finally audio conversion and recording. After some preliminary tests, I synthesized a 30-second study with 766 sound grains. The culmination of my efforts was an eight-minute study based on granular synthesis (Roads 1975). I called it *Prototype* to indicate its experimental nature (see Discography). *Prototype* was an interesting technical experiment, but it was not compelling music. I sensed that granular synthesis had promise, but it was obvious that much more research would be needed to explore its true musical potential. I published a brief article in *Computer Music Journal* about my initial experiments (Roads 1978). As I had other compositional interests, I put aside this research for the time being.

It was not until I arrived as a researcher at the Massachusetts Institute of Technology (MIT) Experimental Music Studio (EMS) in 1980 that I had a chance to continue experiments with sound particles. I used granular textures in my compositions *nscor* (1980) and *Field* (1981), but only at isolated moments when they were deployed for an explosive crescendo. Granular synthesis seemed like a specialized effect. I knew that it could generate sound clouds, formant tones, explosions, and glissandi. What else could it do?

With this question in mind, I began late-night experiments with a new technique: the granulation of sampled sounds. To granulate means to decompose an existing sound into thousands of particles while reassembling them in a new order and microrhythm. I granulated sounds such as alto saxophone tones (played by Earl Howard) as well as snare drum and cymbal strokes. At the same time, I developed spatialization algorithms for scattering the grains to the four Klipschorn loudspeakers in the corners of the studio. These experiments showed me once again how granular techniques could be a powerful resource. I began to dream about musical processes in new ways.

For various reasons, however, the technical conditions at MIT EMS were not ideally suited to this approach. Added to this, I had heavy work responsibilities, including my role as editor of the quarterly *Computer Music Journal.* This left little time for personal research. The combination of these factors did not favor open-ended experimentation. I still thought of granular synthesis as a fascinating phenomenon with untapped potential. But I did not yet have a vision of how to compose interesting music with granular clouds.

The mid-1980s saw a spike of interest in granular synthesis on the part of Barry Truax working in Vancouver, Canada. He programmed a specialized device that could realize multiple streams of granular synthesis in real time (Truax 1986, 1987, 1988). This meant that he could quickly explore a much broader range of variations than I had. His explorations opened up a realm of new musical possibilities, specifically in the play between synchronous and asynchronous grain sequences and manipulations of grain duration.

By the late 1980s, technology had greatly improved. Personal computers and high quality sound cards opened up fresh possibilities for the synthesis and transformation of microsound outside of university laboratories. By 1988, I had developed new implementations of granular synthesis and granulation at home on my Apple Macintosh II computer.

In 1991, I developed another particle synthesis technique called **pulsar synthesis** (Roads 1997, 2001), which appears in parts of *Clang-tint* (1994). I later employed this technique in *Half-life.* (I explain more about pulsar synthesis later.)

In 1995, working in Paris at what is now the Centre de Création Musicale «Iannis Xenakis» or CCMIX, John Alexander and I wrote Cloud Generator, a program for granular synthesis and granulation of sampled sounds. Cloud Generator provided a graphical interface for my granular synthesis and granulation algorithms. It offered a "design-then-render" type of interaction, in which the rendering of a sound cloud could take several seconds.

By the time of my arrival in Santa Barbara in 1996, the use of granular techniques around the world was becoming widespread. I was beginning to write the book *Microsound* (Roads 2002), which was leading me to much reflection on the aesthetic implications of particulate materials and processes.

In 1997, Stephen Pope and I developed a new implementation of pulsar synthesis. Around the same time, I wrote a program for granulation of sound files in which each grain passes through a unique bandpass filter. (I describe this in more detail later.) Both of these programs operated in real time,

which let me quickly explore a wide range of possibilities. These programs were key to making *Half-life.*

Composition, however, requires inspiration as well as technique. Two pieces piqued my interest. I knew that Horacio Vaggione's *Schall* (1994) was a landmark when I first heard it at the electro-acoustic music festival in Bourges, France. *Schall* is composed completely out of sound particles derived from a piano that are projected on various time scales. In 1997, Ken Fields, a University of California, Santa Barbara graduate student, played me his *Life in the Universe,* an intriguing mixture of granulated voice with distant sinusoidal textures. It became clear that I could combine techniques of phrase construction developed in *Clang-tint* (which already used pulsar synthesis) with granulation processes. 24 years after my initial experiments, I finally had a clear idea how to proceed.

SOUND MATERIALS AND TRANSFORMATION

The composition of *Half-life* began in January 1998 with the synthesis of a 14-second sound file made with pulsar synthesis. Pulsar synthesis generates a train of sound particles. Each pulsar particle repeats at a fundamental frequency, with a formant peak in the spectrum above the fundamental. Depending on the fundamental frequency, one can produce either rhythms or tones. I controlled the fundamental and formant frequencies by separate time-varying envelopes that I drew on the screen.

The 1997 pulsar synthesis instrument used to make *Half-life* was simple compared to the PulsarGenerator program that Alberto de Campo and I later made (Roads 2001). The 1997 pulsar synthesis instrument was controlled by five graphically-drawn envelopes:

1. Fundamental frequency over the duration of a pulsar train
2. Formant frequency over the duration of a pulsar train
3. Amplitude envelope over the duration of a pulsar train
4. Stereo spatial position over the duration of a pulsar train
5. Waveform of each pulsaret (a pulsar = pulsaret + silence), which was fixed over the entire train.

The next aesthetic decision was central to the compositional process: I granulated the pulsar train. This is significant, as it differentiated my approach from that of Vaggione, whose particulated sound world derives consistently from the acoustic orchestral instruments. (Despite this aesthetic difference, I greatly admire Vaggione's work; see Roads 2005.) The decision to granulate synthetic particles was a conscious effort to make music purely out of electronic materials. I wanted to demonstrate that the

265

medium of electronic music had reached a point of self-sufficiency. In particular, I was tired of the dogma, repeated by traditional composers, that electronic sound was somehow lacking in comparison with acoustic instruments. I strongly disagree.

Granulation can spawn a vast amount of output sound material from a tiny amount of input. A given sound can be time-stretched by a factor of 100 or more. Simultaneous with this telescoping effect, other processes may also be occurring, such as pitch-shifting, filtering, and spatial scattering. By shrinking the grain duration one can cause the sound to dissolve into broadband noise, and by varying the grain density one can play with the sound's transparency and mass. When the grains are synchronized (aligned in time) this leads to pulsation and pitch formation, while asynchronous grains generate turbulence in the granular cloud. The product of all of these transformations is a very large space of mutations from one state to another.

I also created sound particles directly by **transient wave writing** (Roads 2002). In this method, one draws individual particle waves in the window of a sound editor and sculpts them with various software implements (narrow-band filtering, envelope reshaping, and so on). The last important sound source in *Sonal atoms* was a three-second recording of steam.

SONAL ATOMS

Based on the original pulsar train, I produced enough material for four movements. (I eventually discarded two of these.) In the end, *Half-life* was organized in two distinct parts: *Sonal atoms* and *Granules.*

In *Sonal atoms,* I wanted to shift the musical discourse away from continuous, stationary, and homogeneous signals (such as pitched tones) to intermittent, non-stationary, and heterogeneous emissions (pulses, grains, and noise bands). Thus, the sound universe of *Sonal atoms* is a concentrate of punctiform transients, fluttering tones, and broadband noise textures **[Example 2]**. Only a few stable pitches appear, the result of unusually regular particle repetitions in the middle of the audio frequency range.

Increased heterogeneity in musical material leads to a proliferation of singularities—events that appear only once. For example, I could start with a single particle, and from it breed a family of different sounds by methods such as **replication** (repeating the particle many times to form a pulsation or tone, depending upon the time interval between iterations) combined with pitch-shifting and filtering.
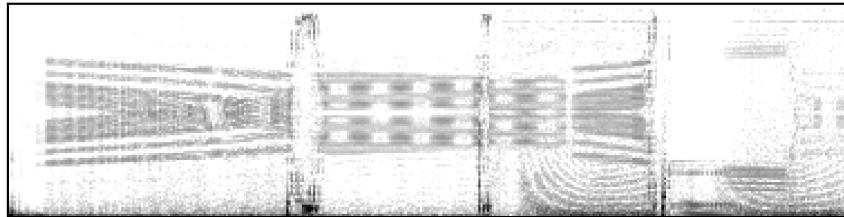
Example 2. Sonogram of the First 15 Seconds of *Sonal atoms.* The vertical scale represents frequency, plotted linearly from 0 to 22 kHz. Notice the broad noise bands that are interrupted by vertical clicks and pops.

On a macro time scale, the work unfolds without formal repetition of subsections. The work is full of iterations, however, on the micro time scale. Pitched tones are, by definition, repetitious in their internal structure. Each pitched tone that appears in *Sonal atoms* was constructed by replication of a single particle **[Example 3]**. For example, when the time interval between successive iterations of a particle is less than 25 ms (corresponding to the wavelength of a low-frequency tone at 40 Hz) a 20-times replication forms a pitched tone. A replication interval between 25 and 50 ms generates ambiguous sounds, where pitch meets pulsation. When the time interval between successive iterations is greater than 50 ms (corresponding to the wavelength of a vibration at 20 Hz) the replication generates a repeating pulsation, which can be sculpted into a dramatic introductory sweep or a fading echo, depending on its amplitude envelope.

Another place where internal repetition appeared was in the pseudo-reverberant tails of certain pulse clusters. Rather than use generic global reverberation, I would stagger multiple copies of a sound with diminishing amplitudes to create an impression of increasing distance. In this way, I could exactly match the color of the pseudo-reverberant tail to the initial excitation particle.

As is obvious in the first few seconds of the piece, spatial movement is fundamental to the structure of *Half-life*. I applied a battery of techniques to position sounds on multiple time scales, from particles to large phrases. At the lowest level, my granulation algorithm assigned a unique spatial position to each grain that it emitted. This essential condition contributes to a three-dimensional spatial quality of the resulting textures. Other strategies included balancing (amplifying one channel over another), motion panning between channels, layering of a slightly delayed copy in one channel, panning with Doppler shift to enhance the sense of motion, binaural filtering

267
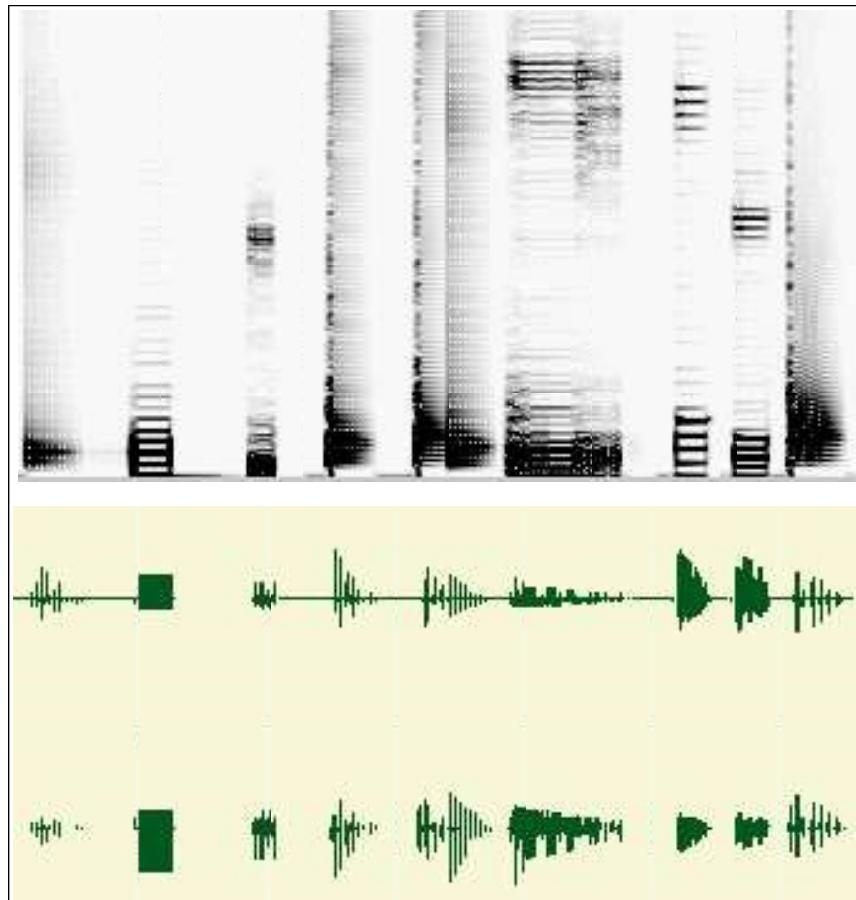
Example 3. Sonogram (top) and Stereo Sound File Image (bottom) of a Particle Melody between 2:19 and 2:22 in *Sonal atoms.* These pitched tones were produced by replicating individual particles. The frequency range of the sonogram is between 10 Hz and 6 kHz.

(for simulating the effect of sounds emanating overhead), and phase manipulations. Phase manipulations alter the spatial image of a sound: narrowing, widening, or shifting the apparent source location. For example, by phase inverting one channel of a stereo pair, a sound's image shifts, projected in relief, as it were. In other cases, I extracted the pure monaural

part of a stereo signal and then phase inverted it to control the width of the stereo image. (Such manipulations mean that *Half-life* is not monaural compatible. This means that if it is broadcast with both channels mixed to one, both its spatial and spectral character will be strongly affected.)

Although the piece was composed in two channels, it was also designed to be performed over multiple loudspeakers. Indeed, for the first performance I played it over 28 loudspeakers scattered around a large auditorium (1998, Australian National Conservatory, Melbourne). For me, projecting *Half-life* in space is an opportunity to perform, since each hall and every sound system requires a unique adaptation.

GRANULES

For the second part of *Half-life, Granules,* I elaborated the original pulsar material by granulation, turning it into flowing streams and clouds. One of the key factors in granulation is the density of grains per second. When the density is high, the source material is reiterated, with numerous grains superimposed in time. When the density is low, the source material is cavitated—pocked with holes.

As mentioned previously, the granulation instrument applied a bandpass filter to every grain. This filter had a "constant-Q" characteristic. The term "Q" refers to the ratio between the center frequency of the filter and its bandwidth, a musical interval. "Constant-Q" means that this musical interval is preserved regardless of the center frequency. For example, given a Q factor of 2, the bandwidth of a filter centered at 100 Hz is 50 Hz, with a low frequency boundary of 75 Hz, and a high frequency boundary of 125 Hz. If, on the contrary, the center frequency is 1000 Hz, then the bandwidth is 500 Hz, that is, between 750 Hz and 1250 Hz. Since frequency perception is logarithmic, the two filters correspond to the same musical interval: 1.666..., or a major sixth.

In *Granules,* the center frequency of each grain's filter was selected by a random choice between two limits that I set. At high grain densities, this produced a texture in which up to several hundred independent filters were operating at any given second, leading to highly animated microtextures.

The core of *Granules* is a long flowing granulation gesture that I call the Grand Descent **[Example 4]**. The Grand Descent involved a continuous downward pitch-shifting that uncovered layer upon layer of sound microstructure. The particle flow in *Granules* is very different from that in *Sonal atoms,* in that the entire structure is a slow release of energy, bubbling down to the depths, proceeding inexorably to a sputtering end.
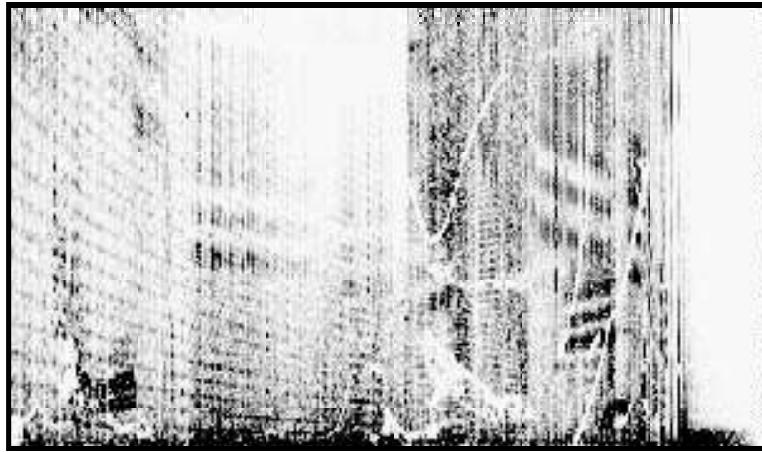
Example 4. Sonogram of the Grand Descent, from *Granules*. The plotted excerpt begins at 83 seconds into the piece and lasts 81 seconds.

MULTISCALE PLANNING

How did I arrive at the macroform of *Half-life*? There was no preset design. Rather, the strategy was to generate the sounds, to study and classify the sounds, to pick, choose, and transform the sounds, and finally to connect and layer the sounds.

Rather than strictly top-down or bottom-up preplanning, I followed a strategy of **multiscale planning** in the presence of sound. By multiscale planning, I mean that I was not limited by either the original sound material or a grand macro design. I began by organizing phrase structures from the sequencing and layering of individual sound objects (a bottom-up strategy). When I sensed the possibility of a large-scale gesture emerging, I would change direction (working from the top down) in order to assemble it. When I found myself in a situation where I had several large chunks of a piece, but nothing to connect them, I would change strategy again and synthesize new connective tissue. At any point in the work, I might scatter newly-generated particles, like salt and pepper to spice up a sauce.

For example, midway into *Sonal atoms,* I set up several **zones of attraction**. Sounds gravitate around zones of attraction. In *Sonal atoms,* up to 52 tracks converge within brief zones of attraction (1:41-1:48, 2:39-2:43, 3:21-3:26). I often found it useful to listen at half-speed in order to make

270

fine adjustments in the microrhythm. The final stages of editing involved an accumulation of details. For example, a transition that had originally been a simple crossfade between two stereo sound files became a zone of attraction by inserting dozens of individually-tuned particles across a two-second transition.

Multiscale planning is essentially an intuitive process, and is certainly not predictable because it is based on a trial-and-error methodology. In this approach, there are no shortcuts; it is usually quite time-consuming. Dead-end experiments are an inevitable part of this process. As previously mentioned, I composed four movements of *Half-life* before I decided to discard two of them. Nonetheless, for me this is the only way to tackle the medium of studio-based electronic music. A sound-oriented multiscale approach is one of the major differences between this medium and that of traditional instrumental composition, where the palette of sound is preformed and symbolically coded on paper.

STUDIO TECHNOLOGY

The technology of *Half-life* was modest. I used two computers. The first was an ageing Apple Macintosh Quadra 700 computer (40 MHz, purchased in 1992). This was connected to the Studer Dyaxis, a multitrack audio mixing device consisting of a signal processing card (for filtering) and a box that performed signal mixing as well as digital-to-audio and audio-to-digital conversion. (I bought the Dyaxis in 1988; it is no longer commercially available.) The second computer was a 1997 Apple Power Macintosh 8600 (200 MHz) with a Digidesign Audiomedia III sound card. My pulsar synthesis and granulation programs run on the 8600. Both were written in James McCartney's SuperCollider 1 language (www.audiosynth.com). The sound monitoring system consisted of a Mackie 1202 mixer, Threshold S/500 II amplifier, and B&W (Bowers & Wilkins) 803 Matrix loudspeakers.

I used several graphical sound editors in constructing the piece: BIAS's Peak, Passport Design System's Alchemy, and Alberto Ricci's SoundMaker. I should also cite Arboretum's Hyperprism, whose graphical approach to time-varying continuous sound transformation I consider to be a model. Thanks to these programs, *Half-life* was honed in microscopic detail, on a particle-by-particle basis. This led to great diversity in the sonic material, even though it was derived from just a handful of source sounds.
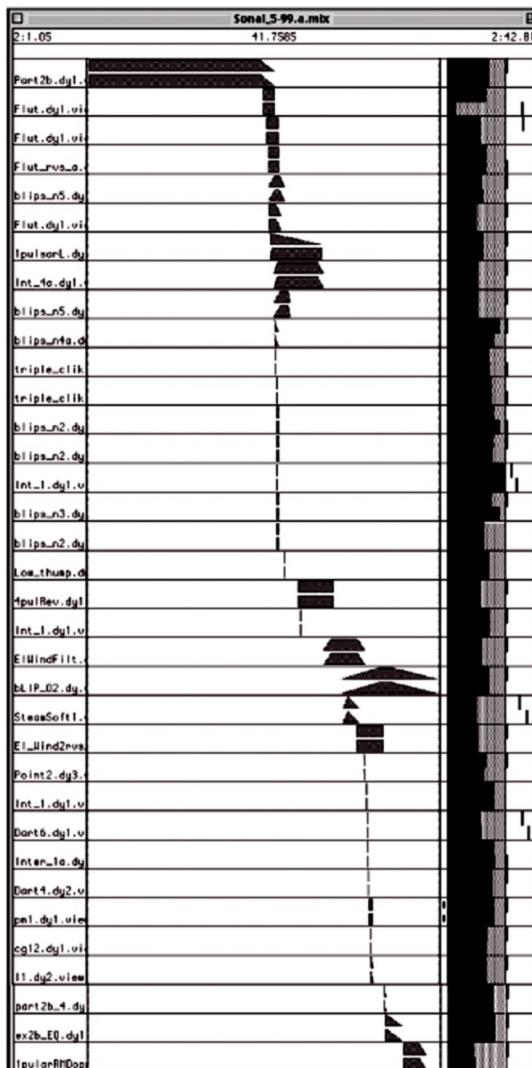
Example 5. MacMix Screen Shot of a 41-second Section of the Mix of
Sonal atoms **in May 1999.** 35 stereo tracks are shown.[90]

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[90] Notice the two points of attraction, around which many sounds gravitate. In MacMix, each sound had to reside on a separate track. This stands in contrast to a program like Digidesign's Pro Tools, for example, in which a single track can

272

I assembled *Half-life* with Adrian Freed's MacMix, a graphical mixing program for the Dyaxis. Work with MacMix involved building up mesostructures from individual sounds. When a given section reached a certain level of complexity, I would mix it down from multiple tracks into a stereo version. Then I would import this stereo version as a new foundation for further layering. I commonly used dozens of tracks, not to create thick layers, but to design intricate filigrees **[Example 5]**. Technology marches on, however, and *Half-life* is the final piece that I realized with the Dyaxis/MacMix combination.

HAPPY ENDING

In the time since I composed *Half-life,* I have realized a number of pieces using essentially the same aesthetic and technical approach. In this collection, called *POINT LINE CLOUD,* the sensations of point, pulse (series of points), line (tone), and cloud (texture) emerge as the density of particles increases. Sparse emissions produce rhythmic figures. By cloning particles in rapid succession, one can induce an illusion of tone continuity or pitch. As the particles meander in time and in frequency, they flow into streams and rivulets. Dense agglomerations of particles form clouds of sound whose shapes evolve over time.

The compositions in *POINT LINE CLOUD* are meticulously organized, but this does not mean that they were planned in advance. To the contrary, they are the result of intense encounters with sound. One might say that they are highly organized in the same sense as a stone sculpture, which embodies thousands of decisions and subsequent gestures on multiple scales.

POINT LINE CLOUD is the product of certain technical developments but also an aesthetic vision. This article documents how technology and my aesthetic viewpoint evolved over a long period of time. In hindsight, it may seem obvious where this research was leading, but it was not obvious to me. Nor is it obvious where it will lead in the future. Together with some bright graduate student researchers, I am exploring several threads of inquiry. Please stay tuned.

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contain any number of separate sounds. Note: the times indicated in this mix do not correspond to the timing of events in the final piece recorded on compact disc.

ACKNOWLEDGEMENTS

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APPENDIX: PERFORMANCES OF *HALF-LIFE,* 1998-2003

May 1998, Next Wave Festival, Australian National Conservatory, Melbourne, Australia, with sound projection over 28 loudspeakers

November 1998, CREATE concert, University of California, Santa Barbara

November 1998, DAFX 98 conference, Universitat Pompeu Fabra, Barcelona

June 2000, Synthèse Festival, Bourges

September 2000, Swiss Center for Computer Music, Zurich

February 2001, Engine 27, New York City

May 2001, El Rey Theater, Los Angeles (concert with Autechre and Russell Haswell)

September 2001, Olhares de Outono Festival, Portugal

April 2002, L'Espace Jean Renaudy, Paris

September 2002, Ars Electronica, Brucknerhaus, Linz

September 2002, Rhiz, Vienna

October 2002, Conservatory of Music "Benedetto Marcello," Venice

November 2002, Centre ADAC, Paris

April 2003, All Tomorrow's Parties UK, Camber Sands

November 2003, Paris Planetarium, Cité des Sciences, Paris

November 2003, Istanbul Technical University, Istanbul